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Engineering News-Record

Devoted to Civil Engineering and Contracting. McGraw-Hill Company, Inc.

WHEN, during 1919 and 1920, it became evident to officials of the Lincoln Highway Association that the need for stimulating interest in highway construction was no longer present, their attention was directed toward comprehensive specifications and more durable construction, safety and convenience of road users, and roadside beauty. It was then that the one-and-one-half-mile Ideal Section, lying between Dyer and Schererville, 32 miles south of Chicago, was conceived. One of the specifications was that the highway should be lighted. The cover picture shows the effective protection given night drivers by the specially-developed 250-candlepower units.

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WOOD BLOCK FLOORS

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

McGraw-Hill Company Inc.
JAMES H. McGRAW, *President*
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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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Engineering News-Record is a consolidation of *Engineering News* and *Engineering Record*, effected in 1917.

Engineering News was founded in 1874 by George H. Frost, as the *Engineer and Surveyor*, which title subsequently became the *Engineer, Architect and Surveyor*, then *Engineering News and American Railway Journal* and finally, *Engineering News*, under the successive editorships of D. McN. Stauffer, Arthur M. Wellington and Charles Whiting Baker.

Engineering Record was established in 1877 by Henry C. Meyer as the *Plumber and Sanitary Engineer*. The name was subsequently changed to the *Sanitary Engineer, Engineering and Building Record* and, finally, to *Engineering Record*. During his ownership of the paper, Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor in 1902, and was succeeded by E. J. Mehren in 1912.

The Contractor was consolidated with *Engineering News-Record* in 1918.

E. J. Mehren became editor of *Engineering News-Record* at the time of the consolidation in 1917, and was succeeded by Frank C. Wight, Jan. 1, 1924.

The staff of *Engineering News-Record* consists of

New York: Frank C. Wight, *Editor;* M. N. Baker, F. E. Schmitt, R. K. Tomlin, Jr., C. S. Hill, J. W. Shaver and Van Tuyl Boughton.

Chicago: W. W. DeBerard, E. E. R. Tratman.

San Francisco: N. A. Bowers.

Codifying the Art of Concrete

AFTER four years of work, and with the advantage of the criticisms of its nearly three-year old preliminary report, the Joint Committee on Concrete and Reinforced Concrete has completed a standard specification for concrete and reinforced concrete. The specification is not yet available, but an abstract of its contents was presented to the American Society for Testing Materials last week. This is a notable and useful work. As the chairman of the committee said last week, it cannot be expected that the twenty-five men comprising the committee have a monopoly on the knowledge of concrete. There will naturally continue to be those who differ in details from the theories and methods set forth in the new specification. Indeed, the unanimous signing of the report does not indicate unanimous consent of all of its provisions but merely the belief that it most nearly represents a consensus of views on a by no means completely understood subject. But the specification, as far as can be told from the explanation of its significant features, is an important document which will do more than any other one thing to standardize the theory and practice of concrete construction. And in doing this it may be pointed out that its major function lies in raising the standards and increasing the knowledge of those who are below the average in the concrete art. For those who have studied concrete as thoroughly as the members of the committee it will be used for what it is—that is the consensus of views of twenty-five men, but the great need in the concrete art today is the education of the vast body of those who are designing and building concrete structures with only the most elementary basic knowledge of the material and its behavior. For them this compendium, whatever may be its occasional peculiarities, cannot fail to be an education in itself.

Broadening Activity

THROUGH the picturesque hurry and bustle which marked last week's meeting of the American Society for Testing Materials as usual, there could be perceived quite clearly that the society's field of work is broadening steadily and rapidly. The broadening movement has been in progress for some years past, as can now be recognized. Years ago it seemed that the work of the society would always be limited to the basic raw materials, such as steel, cement and brick. But this was a primitive view. The specification work long ago extended to process materials and intermediate products. Only recently, however, and this year more particularly, has it been obvious that the possibilities and needs in the direction of broadened specification work are virtually limitless. The needs of technical commerce create an ever wider demand for better definition of commercial products in the mutual interest of maker and user. Under the stimulus of this demand, the growth of specification-making activity is healthy and fruitful. Long-continued growth of the same kind is assured. The materials of engineering and technology are almost endlessly numerous, and each in its turn will call for the fixing of quality by test and inspection. The gain to both maker and user resulting from this work, and the even more important gain to the community at large, is now too well established to admit of question. And with the further spread of specification and test practice there will also come about that desirable condition which formed the subject of a special plea at the meeting, namely, the extension of specification quality guarantees to even the smallest consumer of engineering materials.

A Matter of Efficiency

THROUGHOUT all the growth of the American Society for Testing Materials, the specification-making machinery which it provided in its early days, fifteen years ago and more, has continued to function in most satisfactory manner. Probably this condition will not always continue; no system of procedure devised for the conditions of one era, is likely to prove the best for quite different conditions in a later era. In the course of time the society's working method may need to be revised. There has been no indication hitherto that the time for revision was approaching; slight friction occasionally developed in unimportant points, but nothing indicated that the method itself was at fault or in need of change. At this year's meeting, however, the incident of some steel specifications which could not be put through in the form reported by the committee gave a hint that the time may come

when improvement of procedure may become necessary. In this incident, reported in our account of the meeting, it became apparent that a committee so large as the steel committee, with well over a hundred members, is not fully effective as a device for harmonizing views and reaching the soundest adjustment of technical counterclaims. The action of the committee, in reporting its work to the society with no attempt at explaining revisions or controversies, was strictly in accord with precedent; yet it was a factor in giving the minority the support which it received. Aloofness on the part of technical committees does not encourage genuine participation of the society in the specification work. Nor has such participation been obtained or sought for in recent years, though the show of rendering a report and asking for a vote of adoption has survived as an idle formality. One further phase of the steel dispute is of interest: the fact that the matter came to public attention only because immediate standardization was requested, in order to have the revisions embodied in the book of standards to be printed this year, and therefore a nine-tenths vote was required. In any other year the majority opinion would have prevailed and the controversy smothered instead of adjusted. This is not the best way to sound results and smooth working. If the society is to assure itself of permanent efficiency in specification framing under its broadening program, it may soon have to plan for modifying its working methods.

Gallon Samples at the Polls

AMONG the features of the election campaign for a $2,000,000 water-works improvements bond issue at Wheeling, W. Va., described in some detail on another page, a last-minute appeal was the display in each voting booth of samples of unfiltered and of filtered water each in gallon bottles. The article will repay reading by those engineers who wish to avoid too many painful repetitions of seeing their carefully made plans for water-works or other public improvements postponed or forever lost because of opposition or apathy at the polls. This is not saying that every bond issue for municipal improvements should be approved by the voters as soon as it is put before them. The very object of such elections is to let those who have to foot the bills have their say as to whether the bills should be incurred. But hundreds of bond issues for much needed improvements are defeated because the exact character, the benefits, and the cost incidence of the improvements are not thoroughly understood by the voters. The many defeats of water-works bond issues at Wheeling, of which Mr. Laboon mentions only two, were largely the result of conditions that happily do not arise in all cities, although they do occur in far too many. To put it mildly, some of the past defeats at Wheeling were due to the ineptitude of the city government and lack of discrimination as to the merits of some of the projects on the part of the city authorities and the citizens of Wheeling alike. The project that was finally adopted, unlike some of those defeated, was based on good engineering and its merits were adequately displayed to the public by a leading representative of the engineering firm responsible for the plans finally adopted and now well on towards completion. Other cities would do well to take notice.

Engineers as Voluntary Advisors

PITFALLS await the engineer when he assumes the responsibilities of voluntary adviser in civic affairs. The dangers are perhaps greatest when he is serving as one of a committee appointed by an engineering society to report on some public matter. When working by himself and entirely on his own initiative the engineer who takes up civic questions is likely to be cautious in his public utterances on the platform or in the press and to confine himself to fields in which his personal knowledge and experience and professional reputation qualify him to speak or write. But in civic committees the engineer is more likely to be induced to go into fields outside his own and presume to speak or write without authority. It is only in cities of considerable size, and not always then, that local engineers are available to deal authoritatively with highly specialized subjects, like bridges, transportation, waterfront improvements, or the various branches of sanitary engineering. When this is the case and either an engineer or an engineering committee assumes the responsibility of giving advice, and is not provided with funds to call in some one who really is expert on the subject in question, there is always the danger that the blind will be led by leaders who are only less blind. This suggests another danger. It is that the citizenry think that because an engineer or group of engineers in their midst is willing to proffer a certain amount of information and advice gratuitously, it is quite unnecessary to engage engineers and pay them for detailed engineering services.

Sewage Sludge Still With Us

A SLOGAN used in the early days of company promotion of the septic tank was "No Sludge." Whatever the earlier hopes or expectations of Donald Cameron in this respect, he and others soon found that the sludge problem was still with them as it is still with us a quarter century later. That the advent of the Imhoff tank and the subsequent improvements in its design and operation still leave much sludge to be handled and that in an Imhoff installation for a large city, the sludge-drying beds take up a large acreage and present numerous problems of design and operation, are shown by the article on the sludge-drying beds at the Baltimore sewage-works on another page of this issue. A spread of 10 acres for the sludge, lines of industrial railways, and men to load the sludge onto cars are all provided at Baltimore. After all that, whether at Baltimore or elsewhere, there is still the question of ultimate disposal. Experience at Baltimore and at Rochester have given promise that after open-air drying on sand beds the sludge will be taken away by farmers and truck gardeners for use on their land, year in and year out, and perhaps paid for as well. At Baltimore, the farmers after losing interest were coaxed into continuing the removal of sludge by the city providing and operating equipment to load it into their wagons.

A slackening of interest in the use of sludge on land seems to have been the experience the world over. In England when chemical or other treatment plants producing sludge were first opened up, farmers would pay a small unit price for the privilege of coming and hauling it away. Then the price would be reduced gradu-

ally, accumulations at the works meanwhile increasing until finally the management would be glad to get rid of the sludge without receiving any revenue from it. At a few sewage-works in Great Britain, but apparently very few indeed, sludge has been made into either a fertilizer base or mixed with richer materials into a complete fertilizer and sold. There has been little if anything of this sort in the United States, although at Baltimore for a time a private contractor did take some of the sludge and run it through a drier for the recovery of a commercial product. Something similar in result if not in method was tried at sewage-works in Ohio and may possibly be still in use. At Birmingham, England, huge volumes of wet sludge have been piped to land and plowed under. But on the whole, the world over, sewage sludge is accumulating at or near Imhoff and other tanks or is being got rid of spasmodically and with more or less difficulty.

As the supply of fertilizer becomes scarcer and the price higher, the demand for low-grade material to go into its manufacture may so increase, and with it engineering skill in design and operation, that Imhoff tank sludge will have a selling value which would at least help reduce the cost of sewage treatment, but along with the other developments there will have to grow, in the United States at least, municipal administrative efficiency in order to successfully carry on a business of this sort. This applies not only to sludge from Imhoff tanks but also to that from the activated-sludge process. True, the latter has raised high hopes because of its larger nitrogen content, but it must be remembered that before any sewage sludge can enter into a commercial fertilizer its moisture content must be reduced to 10 per cent, which greatly increases the difficulties and expense of sludge treatment and makes it just that much more of the sort of manufacturing and business enterprise that American municipal conditions make it difficult to handle successfully.

Giving the Contractor a Square Deal

A STINGING rebuke is administered to unsound engineering practices in the two noteworthy contract lawsuits reported in this issue (p. 21). On the face of the judgments rendered, the case is even worse: two sets of engineers are in fact convicted of misrepresentation and fraud just as surely as though they had been found guilty on a criminal count. They were charged in the suits with deliberate, knowing alteration of records on which contractors depended for proper cost and bid calculation. Court and jury have sustained the charge, in the one case without any qualification whatever, in the other case with the shadowy reservation of possible mistake on the part of the engineers.

The issue as outlined by the judges was clear: Did the engineers act honestly? They are convicted of having acted dishonestly. They indulged in ordinary sharp practice for gain—we again follow the stern and uncompromising view taken by the judges. One set of engineers made hard material appear soft on the bidding plans; the other set made soft material appear hard. In both cases, the contractor was sure to lose if he believed the plans, as he might readily do and in law was bound to do. The gain that might be realized through the deception was not the private gain of the engineers, except as their prestige might be increased if they could manage to obtain low bids on expensive work. But if the engineers deceived in the interest of the state rather than in their own interests, they cannot make their dishonest acts honest. At best, their dishonesty will seem a little less black, though indeed it is more difficult to explain.

In the Barge Canal case it was charged—and found—that the engineers had disguised hardpan under harmless names like sand, gravel and clay. They also accomplished the remarkable feat of calling a stone and timber crib "filled material." These names made the material seem easy to excavate, and assured a low bid; and the court found convincing proof that they knew the crib was there and knew the hardpan and other very hard material were there, and knew that these materials would be much more costly to remove than the materials marked on the plans. In the Passaic Valley Sewer case the engineers dressed up mixed glacial drift with the fantastic name "cemented triassic formation."

Geologists are apt to call almost anything a formation; but they do not call pleistocene glacial drift triassic, nor do they call loose deposits cemented. Nor do engineers. Triassic sandstones and trap are found west of the contract site and are quite easy to tunnel through, but the glacial drift at the site was bound to make tunneling costly and difficult. The geological fantasy "cemented triassic formation" was well adapted to deceive. And it did deceive, to the tune of nearly a million dollars lost by the contractor.

Subsurface exploration has always been a special grief of the engineer; in many cases also of the contractor. There is more to be said on this side of the matter than the learned judges have written into their opinions. This, however, must be deferred for discussion until another occasion. On the score of interpretation, it needs only to be said that whether or not the engineer is justified in interpreting boring records, it can be seen very clearly that in the present cases the interpretation was condemned as dishonest not so much because it was interpretation but because it was deceptive interpretation.

For the present, what we desire above all else to bring to the attention of engineers is the re-emphasis of old principles which speaks from the decision. What the engineers did in the two cases is only of secondary importance after all; the important thing is what they did not do. They failed to give the contractor a square deal, to tell him fully and openly what they knew of the ground and what they did not know, to the end that he might judge for himself concerning the risks and uncertainties of the proposed work. We read the one prime instruction out of the decision, that the bidder is worthy of a square deal.

To repeat a well established truth: Bidder and owner have a joint interest, namely, to do the work required as cheaply and as well as possible. It can profit no one to indulge in sharp practice upon the bidder, but on the contrary it can profit him much to help the bidder as fully as conditions permit. These principles have stood for uncounted years. Yet from time to time they need to be reaffirmed and re-emphasized. The present decisions thus reaffirm them, and once more bid us to incorporate them in our habits of thought.

Materials and Specifications Discussed at Atlantic City

Increased Activity Shown by American Society for Testing Materials—Special Steel and Fatigue the Leading Subjects—Cement and Concrete in Background—Society to Develop Knowledge of Materials

DISCUSSIONS of special steel alloys, fatigue of steel, and the systematization of testing methods were among the most prominent features of last week's annual meeting of the American Society for Testing Materials, held at Atlantic City. An unusually broad range of subjects was dealt with, however. There appeared to be a distinct increase of activity over that exhibited in recent years, and all parts of the large program engaged close attention. Cement and concrete were somewhat in the background, especially as the expected final report of the Joint Committee on Concrete and Reinforced Concrete was presented only in brief oral abstract and received no discussion.

A new arrangement of meetings was tried this year. Double sessions were held each morning and evening, but the afternoons were left open for committee conferences and private discussions. The increased activity of the meeting may be in part a reflection of this change in plan. Nearly every committee managed to straighten out residual differences in a final session before presenting its report, and the double sessions with their wider range of subjects kept the members of the society quite continuously engaged in the work of the meeting.

While specification work was in no way behind that of previous meetings, nevertheless a notably large number of papers reporting studies of properties of materials was on the program, and this part of the society's work rather outweighed the other. This is in harmony with recent movements in the society to give greater attention to advancement of knowledge of materials. To carry out this new purpose a committee on correlation of research has been organized, and the plans for the society's future work are to be developed in such a way as to give this purpose equal importance with that of specification making. At the same time, the specification work of the society showed a distinct enlargement of scope. Several new committees reported, most committee reports indicated businesslike activity, and consideration of the committee reports in the meeting was slightly less routinized than has been the case in recent years.

A plea for the small user of material presented at one of the sessions by Thomas H. Wiggin gave rise to animated discussion. It drew attention to the fact that the specification work of the society so far has been of use mainly to the large user, who, because of buying in large quantities, is able to demand compliance with purchase specifications. Various methods were suggested to extend this advantage to the small user. The pertinent comment was made by two or three representatives of producers that the duty of bringing about the desired result rests largely on the manufacturer. The subject was considered sufficiently important to warrant special study on the part of the management of the society to devise means for making the effect of specifications more universal and thereby tending to eliminate subnormal and dangerous material.

Resistant Alloys—A symposium extending over two sessions dealt with the subject of special alloys of high resistance to heat and corrosion. An extended table of data obtained from manufacturers, on the composition and properties of commercial and special alloys, was presented by a committee. Stainless steels and other special alloys, particularly those having a high resistance to corrosion, were discussed from both the laboratory and the service standpoint in a number of papers. Some of the tests reported prove that surprising resistance to corrosion can be attained; for example, in a 500-hr. salt spray test a few nickel-chrome steels showed absolute immunity. However, it appears that the relative resistance of different steels depends on the particular chemical agent to be resisted, and on the whole study of the subject has hardly more than begun. Discussion emphasized the view that any attempt to standardize or establish uniformity in the corrosion-resisting alloy field would at present be quite premature.

Corrosion—Corrosion was also dealt with in the report of the committees on corrosion of iron and steel and on corrosion of non-ferrous metals and alloys, and in several papers. Apparatus for testing the corrodibility of metals was reviewed by H. S. Rawdon, A. I. Krynitsky, and W. H. Finkeldey, and an electrolytic method which was claimed to be an accelerated test for corrosion was described by R. J. Anderson and G. M. Enos; the virtue of the electrolytic method was questioned in discussion, however, as giving results not necessarily parallel to those obtained with plain chemical corrosion.

Recent results of the corrosion tests of sheet steel and iron which have been under way for some years, in charge of Committee A-5, confirm the indications obtained in the earlier results that copper in steel does not increase the resistance of the metal to corrosion when totally immersed in mine water or other water of acid or alkaline reaction, while it does increase the resistance to atmospheric corrosion. Corrosion tests are about to be started by Committee B-3 on six metals (admiralty metal, aluminum, copper, lead, nickel, zinc) in sheet form, by four different test methods with a variety of corroding liquids, under continuous immersion, alternate immersion, spray, and electrolytic action.

Further data on the preparation of steel surfaces for painting were brought out in the report of a subcommittee of the paint committee, D-1, which has in progress an exposure test of samples prepared for painting in different ways. The specimens of new steel now indicate (after seven years) a decided superiority of sandblasting and pickling over hand preparation or over no preparation (mill scale left intact and clean). The samples of old steel show that wire brushing, sandblasting, and cleaning after burning with benzine are of about equal rank, with 80 to 90 per cent present condition of the surface.

Sulphur in Steel—A third report from the Joint Committee on the Effect of Sulphur and Phosphorus in Steel was presented at the meeting. It covered two separate pieces of work: endurance tests of rivet steel, and strength tests of plate (structural) steel in both cases with varying sulphur content. The rivet steel investigation was supplemented by an elaborate metallographic

study. Neither the rivet steel nor the plate steel showed any perceptible influence of sulphur, either on strength properties or on the endurance (of rivet steel). The sulphur in the tests ranged up to 0.17 per cent. The investigation program will continue, applying the same tests to steels of other grades that have been applied to rivet and plate steel.

Steel Specifications—The customary annual routine of presenting and passing revisions of a dozen or two steel specifications was rudely interrupted at this meeting, for the first time in years, by a fight led by a small minority which succeeded in carrying its point and preventing the adoption of a proposed revision clause to which it objected. This clause, inserted in several specifications for structural steel, fixed overweight tolerances for individual plates at 1½ times the tolerance allowed on lots of plates. Disregarding the reasonableness of this proposed ratio, the minority questioned the interpretation of the clause, whether it represented a rejection limit or merely a payment limit, and also argued that in practice such a clause would let down the bars to very bad work, the middle of a ⅜-in. plate sometimes being over ½-in. thick. While an overwhelming majority both of the steel committee and of the meeting favored adoption of the clause, the minority had power because certain of the specifications were being presented for immediate adoption as standards, requiring a 90 per cent vote of the meeting. To procure a favorable vote, virtually the same question was brought to vote three consecutive times, but on each vote the small minority managed to exceed the required 10 per cent of those voting, and the clause was finally thrown out in all the structural steel specifications and referred back to the committee.

A matter of rather unusual character brought up in the steel session was a paper by R. H. Smith, "High Tensile Strength With Low Carbon Steels," which reported that ordinary dead-soft steels of 0.09 to 0.13 carbon were hardened to various strengths up to 130,000 lb. per square inch by exceedingly rapid and thorough quenching by means of a special spray quenching jig. Not only was high strength attained, but in a certain heating range also a very high ductility, for example, 50 per cent reduction of area with 110,000 lb. ultimate strength.

Endurance—Much interest centered on the subject of fatigue testing. Various new results obtained in this field within the past year were reported. H. F. Moore and T. M. Jasper summarized briefly the latest results obtained at the University of Illinois, in the joint fatigue investigation being carried on there. This latest work, while generally confirmatory of the prior work, led to the development of a new theory of fatigue, based on the simultaneous existence of two effects, namely the growth of minute cracks in the steel through breakdown of overstressed portions, and strengthening of the material by rearrangement of grains or other components. R. R. Moore reported results obtained at McCook Field, Dayton, in fatigue tests of aluminum. D. J. McAdam, Jr., of the Naval Engineering Experiment Station at Annapolis, reported additional endurance tests made there, and an "accelerated" fatigue test in which the swing of a fly-wheel in a torsion test increases with the yield of the specimen and thereby increases the stress, so that the specimen is broken much more rapidly than in a test made under constant stress. So far as the testing has gone, it shows the results of this test to be strictly parallel to those of non-accelerated torsion tests. He also reported his results on endurance range when there is not complete reversal of stress, in which he finds that the range is fixed in amount, regardless of the values of upper and lower stress limits (up to the elastic limit of the material). This conflicts with results obtained at Illinois, which show an increase of range as the value of minimum stress is raised from negative to positive. A further series of endurance tests was reported by H. W. Gillett and E. L. Mack, again giving indications decidedly different from some of those obtained in the tests made in other laboratories.

Some active discussion developed around these various reports of endurance test results. It was shown particularly by H. F. Moore that supplementary tests at Illinois, which check various results obtained in the other laboratories, indicate that all the divergent results and views are gradually being harmonized. Some comment was made on the probable value of accelerated tests for endurance. Dr. L. B. Tuckerman pointed out that it will always be necessary to check the meaning of accelerated methods by old-fashioned endurance runs. Dr. Tuckerman also referred to the ratio of endurance limit to weight, which was singled out by R. R. Moore as an important gage of value of a metal, and pointed out that while this may be directly applicable to tensile service a different comparison must be made for compressive service; here light metals have a relatively greater value because of the stiffness of construction of struts which they permit of obtaining, so that in this instance the value is more nearly proportional to the ratio of endurance limit to the square of weight.

How far the endurance testing is being carried at the present time was illustrated by some figures quoted from the laboratory of the Aluminum Co. of America. In the endeavor to obtain a positive check on the value of the endurance limit of aluminum (believed to be about 12,000 lb. per square inch), several tests are in progress at unit stresses of 4,000 to 8,000 which have already gone beyond 1¼ billion cycles, and without fracture.

Cast Iron—In the field of cast iron, car wheels and pipe were main subjects of activity. Richard Moldenke in "Recent Investigations of Cast Iron for Pipe" reviewed the facts as to commercial pipe and concluded that not only are more severe specifications unwarranted but present specifications are difficult to meet. J. T. Mackenzie reported a large series of transverse tests of bars from pipes, which led him to recommend specifying a minimum deflection of ¼ in. at 1,900 lb. load (24-in. span, 2x1-in. bar) without regard to deflection at rupture, in order to exclude brittle pipe. F. A. Barbour, speaking for the user's view, argued for a requirement of ultimate strength and deflection at rupture.

Car wheel specifications, a much disputed subject two or three years ago, have been fully ironed out and were at this meeting advanced to standard, as were also those for pig and for high-test castings.

Chain—Proof testing of large chain produces marked brittleness, according to a paper by C. G. Lutts, reporting tests at the Boston Navy Yard. Annealing removes much brittleness. The brittleness was tested by dropping the link 16 ft. on a 2,000-lb. steel block. However,

the meeting approved as standard a specification for iron and steel chain which provides for proof testing without annealing.

Systematizing Test Methods—Great activity has developed in the field of Committee E-1, on Methods of Testing. It has drawn up complete specifications for methods of tensile and compressive testing, which were accepted as tentative standards. It is also undertaking to define the basic terms used in testing, such as stress, tension, elastic limit, and the like. The reception of the report indicated that the work of the committee will not only promote uniformity and raise the quality of strength testing, but that it will stimulate the study and development of test methods for special purposes. A pertinent illustration of such special development was given in a paper on methods and apparatus used in the Western Electric Co. laboratory for testing thin gage sheet metal and light alloys, by H. A. Anderson.

The vexing question of sieve standardization was brought distinctly nearer to its final solution by the work of this committee during the past year. Extensive tests of sieves and studies of various sieve specifications, together with comparison of the practice of various manufacturers, led to the formulation of a proposed standard scale of sieve sizes, identical with the recently adopted scale of the Bureau of Standards. Wire size has so far been found to have little influence on sieving results, so that one disturbing complication is removed from the problem. The proposed sieve scale was adopted by the society.

Nomenclature—Somewhat parallel to the study of standardization of test methods is the work on nomenclature and definitions in charge of Committee E-8. This committee passes upon all specific terms used and definitions established by the special committees, and deals independently with terms that concern the work of several committees. Two terms in this latter class were defined during the past year, and the definitions accepted by the meeting, as follows:

Clay—An earthy or stony mineral aggregate consisting essentially of hydro-silicates of alumina, plastic when sufficiently pulverized and wetted, rigid when dry and vitreous when burned at a sufficiently high temperature.

Sand—The fine granular material naturally or artificially produced by the disintegration or crushing of rock or slag. (*Note*—When used without a qualifying adjective it is generally understood to mean a product of the natural disintegration of siliceous or calcareous rock. The size of particle and other physical characteristics should properly be taken care of in specifications, and therefore no limits are mentioned in the definition.)

Various specific gravities were also defined by the committee. This part of the report led to some aggressive discussion calling for the adoption and definition of the term "apparent density" to indicate the relation of weight to volume of loose materials, but the committee appeared to be unwilling to adopt this term.

The work of this committee is extending rapidly and promises to lead ultimately to a complete glossary of terms relating to materials and testing.

Timber—A wholly new specification for grading structural timber was reported by Committee D-7, applicable for the present to Douglas fir and Southern pine. It divides timber into standard and common grades, fixes the permissible defects for various uses (knots, shakes, angle of grain, wane) as well as heartwood and sapwood requirements, and tabulates the grades or classes to be used for different members in buildings and bridges. Classifications for other services are to be developed later. Test methods for timbers in specimens and in large-size pieces were also presented, as well as some specifications on preservatives. In connection with the report, J. A. Newlin and R. P. A. Johnson reviewed in detail what has been learned at the Forest Products Laboratory about the influence of defects on the strength of timber.

Paint—Specifications for pigment and for a number of chemical methods were presented. In addition, much investigative work was reported on the chemistry and properties of vehicles and pigments. An elaborate series of tests on ship-bottom paints is in progress, but up to the present it has not gone far enough to indicate any definite conclusions.

Paint and oil problems were discussed in several interesting papers. More experimental work in accelerated or artificial "weathering" of varnishes (under ultraviolet light) was reported by H. A. Nelson and F. C. Schmutz. T. S. Sligh described a method for measuring the stability of mineral oils by oxidation. Another form of oxidation test for transformer oils, called the "life test," was discussed by E. A. Snyder; in this test the sample is exposed to oxygen at a relatively low temperature, and the time when first signs of sludge formation is observable is recorded. The author states that transformer experience has definitely shown this sludging to be the prime factor of deterioration of transformer oils and the "life test" figure to be a correct index of service value. H. B. Pullar recommended further study of the blown oils for paving work, noting that there would seem to be here an opportunity to utilize this product advantageously to overcome the longitudinal waving common to asphalt roads under heavy motor traffic.

Non-Ferrous Metals—Tentative specifications were reported for seamless Muntz metal condenser tubes, brass condenser tubes, manganese bronze castings, phosphor tin, phosphor copper, and silicon copper. Some specifications were revised. A discussion of impurities in babbitt metal was presented in connection with this report, by J. R. Freeman, Jr., and P. F. Brandt; zinc and arsenic were shown to increase the hardness of the material. A compilation of information on high-strength light alloys (duralumin and similar materials) compiled by the committee was also given. The question of lead pipe thicknesses was considered and discussed at some length, with the conclusion that a compromise specification or sizes to harmonize practice in the East and the West is not now feasible.

Concrete Brick—After several years of contention over competitive specifications for clay and concrete building brick, the brick committee, C-3, presented this year a specification for concrete building brick which was accepted by the meeting. It fixes the minimum mean strength as 1,500 lb. per square inch flatwise compression, and 300 lb. per square inch modulus of rupture, with 10 to 12 per cent absorption. Data on the strength of walls built from clay brick were presented by S. H. Ingberg, the series including also some sand-lime brick. The general indication of the test results is that wall strengths are rather lower than assumed heretofore, so that a downward revision of working-load practice may be desirable.

Tile—Specifications for hollow tile, presented by Committee C-10 and accepted by the meeting, establish

three grades (hard, medium and soft) instead of one, with absorption limits of 12, 16 and 25 per cent and mean compressive strength limits of 1,800, 1,400 and 1,200 lb. per square inch of gross area. A clause in the fire resistance paragraph of the specification under which a minimum fire resistance of one hour would have been accepted was eliminated.

Lime and Gypsum—Several specifications were submitted by Committees C-7 and C-11, on Lime and Gypsum respectively. The former included a specification for lime to be used in water treatment. An important change in the lime specifications eliminates the clauses fixing chemical composition and provides only for a minimum content of pure lime. It was proposed to include a footnote suggesting a basis for adjusting payments for lime percentages differing from the specified standard, but this met objection as not being a technical specification clause and was referred to the Executive Committee.

In the gypsum field an increase in permissible length of wall board was made, as longer lengths than 10 ft. are now available. Specifications for partition and furring tile were drafted, and in connection with these a paper on "Properties of Gypsum Tile" was read by J. M. Porter, which showed that commercial tile are highly accurate as to size and of satisfactory strength (over 75 lb. per square inch). As with other ceramic materials, strength and absorption were found to vary in inverse ratio.

Sewer Pipe—A cautionary note was added to the concrete sewer pipe specifications stating that the pipe should not be used where sewage shows an acid reaction. This change being adopted as tentative, the specifications for both clay and concrete sewer pipe were adopted as standard. A lighter-weight pipe is under consideration as an alternative to the present standard.

Cement and Concrete—The sessions on cement and concrete were confined to the reading, and limited discussion, of several papers on the record of tests, mainly on the behavior of concretes subjected to adverse exposure. These will be reported in abstract next week. An outline was given of the tests on field concrete conducted at the Victor building at Camden, N. J., and on the Newark Bay bridge of the Jersey Central R.R. These tests were in collaboration between the Joint Committee on Concrete and the Associated General Contractors. They will be reported in full in a paper before the American Society of Civil Engineers in August.

The report of the Committee C-1 on Cement was submitted by its chairman, R. S. Greenman. The committee has had under consideration during the past year modifications of the current standard specifications for cement. It has examined a number of foreign specifications and has studied numerous suggestions as to revisions which have been submitted. These comprised the following: First, a suggestion that the specific gravity provision be dropped. The committee considers that ultimately this provision will be withdrawn because it does not seem to serve any useful purpose, but it decided not to make any change in the specifications in this regard until some more important change was also to be made. Second, a suggestion that there be some strength test for a shorter period than the seven-day mortar test. The 24-hr. mortar test did not find favor in the committee, although it was proposed that a three- to four-day mortar test be started. This is being considered. Third, compression test for mortar; the committee considers that more data are necessary before this test can be proposed. Fourth, a change in the sulphur and magnesia content qualities. This has not been sufficiently studied to warrant action. Fifth, the proposition has been made that 100-mesh fineness be restored. The committee considers this would not add anything to this specification, and does not propose to follow it.

A laboratory manual for the testing of cement is under way by the committee and should be ready next year. The committee has also been considering all other types of cement, both old and new, and a subcommittee on this subject has been formed with possibilities of action next year.

A. T. Goldbeck, chairman, submitted the report of Committee C-9 on Concrete and Concrete Aggregates. While a number of sub-committees of this committee are at work, apparently none of them have reached a stage where reporting is advisable.

Concrete in Service—The results of the accelerated wear tests on the concrete pavement test at the Arlington farm of the Bureau of Public Roads are reported in a paper by F. H. Jackson and J. T. Paul. The paper gives the results in detail, but the summary of conclusions is the same as that stated in the abstract in *Engineering News-Record*, June 5, 1924, p. 984. H. S. Mattimore, of the Pennsylvania State Highway Department, said that the tests must be interpreted by men familiar with service operations. Crushed stone, he said, is more apt to be uniform when judged by sample than gravel, although this is not applicable to the siliceous gravels of Long Island, which are uniform. R. S. Crum, of the Iowa State Highway Department, said that the Iowa gravels seemed to show up very poorly in the tests, but they were the only gravels available in Iowa and that the result of the tests strengthens the position of the Iowa department against the use of these gravels in road work. D. A. Abrams, Structural Materials Research Laboratory, said that the sand-mortar tensile tests need not be expected to conform with wear tests, and in that respect the Arlington road tests are in accordance with earlier investigations.

A method of securing core samples of pavements was reported by E. E. Butterfield, in charge of the laboratory of the Borough of Queens, New York City. The paper related mainly to the improvements in the technique of pavement core drilling for both the sheet asphalt top and the concrete foundations. It described a portable drill and its operation. It stated that concrete was simpler to drill than asphalt, which changes in consistency with the temperature so that a cutter has to be used in hot weather in place of the core drill. In connection with the drilling and sampling, Mr. Butterfield is studying a method of analyzing concrete content by means of area measurement of closely spaced sections through the concrete, the aggregate volumetric total being then computed by a method similar to that used in earthwork measurement. He has had some results quite concordant with other methods of analyzing content but feels that further study is necessary before he can specify proper spacing of sections to be taken.

In discussion, H. E. Breed stated that from studies he has made it costs about $3.60 for each core of pave-

ment that is taken. A. N. Johnson stated that $5 in his experience would cover the taking and testing of each core. H. L. Howe, Jr., Rochester, N. Y., described an asphalt pavement sampler consisting merely of a pipe die and a jack. The die is set on the part of the pavement to be sampled, a steam roller is run above it to furnish the reaction to the jack, and the die forced down into the asphalt surface. The sampling crew has with it a plug of asphalt to fill the hole.

Joint Committee on Concrete—On behalf of the Joint Committee on Concrete and Reinforced Concrete, Richard L. Humphrey, chairman, presented, for the first time to any of the constituent societies, the standard specifications for concrete and reinforced concrete. The specifications themselves, however, were not available, but the chairman announced that they would be printed in the August *Proceedings* of the American Society of Civil Engineers. The report of the committee consisted in a description of what the committee considered the most important features of the standard specifications and the variations in them from the preliminary standards submitted three years ago.

The present (or second) Joint Committee on Concrete and Reinforced Concrete is made up of five members each of the American Society for Testing materials, the American Society of Civil Engineers, the American Concrete Institute, the American Railway Engineering Association, and the Portland Cement Association. Its first report, comprising tentative specifications for concrete and reinforced concrete, was submitted in June, 1921, and has been discussed thoroughly before each of the constituent societies. In the succeeding three years the committee has been considering various criticisms and reconsidering its earlier report in the light of those criticisms and of some comprehensive tests, mostly on actual structures, which resulted from the earlier specifications. The specifications now submitted are stated to be complete as to general uses, though they may require some special use clauses. As to design they have been written primarily with building construction in mind, but they have general application. They are not submitted as final specifications, the chairman announced that the committee will continue its studies and may in the future make amendments if they are thought to be necessary.

The chairman also announced that the two main distinctions between the standard specifications and the tentative specifications submitted three years ago are, first, that the so-called strength design clause in paragraph 28 has been omitted, and second, that the clause absolutely forbidding the use of integral waterproofing has been amended so that such compounds may be used, but only when specifically ordered by the engineer.

The procedure at the meeting was to have the chairmen of the sub-committees make reports on their separate sections of the specification.

Under quality of materials, both fine aggregate and coarse aggregate are specified in considerable detail, but blanks are left in the grading and in the strength-ratio tests for fine aggregate to be filled in by the engineer. The colorimetric test is to be used unless the mortar strength test is satisfactory. However, a fine aggregate may be used if it makes good concrete even though it passes none of the specification clauses. Under coarse aggregate are the usual quality and grading clauses. In proportioning and mixing the keynote is strength. Proportions are fixed so as to get concrete of desired strength. There are two methods of getting this: (1) The engineer sets the proportions, including water, according to his own analysis of the submitted or possible aggregate, and in setting such proportions he sets also the consistency. If any change in the proportions is required the engineer makes them according to the change in the aggregate and adjusts the compensation. Recognition is given to bulking of sand. A secondary method of proportioning is to be used when time is wanting or when the aggregate is not known. By this, proportions are arbitrarily fixed by the engineer and he is to be guided by the table of proportions which was featured in the earlier report.

Under mixing and placing there is not very much difference. The time of mixing, however, is changed to 1 min. from the 1½ min. of the earlier report. More details are given as to methods of depositing, chuting, removal of water, sea water and alkali exposure and oil or acid exposure.

Under design the committee feels that the specification is far ahead of any earlier report or method. Details of splicing of reinforcement are more explicit; more protection is given against moisture entrance to reinforcement; fire protection is looked after in more detail in that the value of different grades of aggregate according to their fire resistance is stated; more attention is also given to both expansion and contraction and watertight joints. In column design the method is the same as in the earlier report, but somewhat more detailed. In this method, as will be remembered, the shrinkage stress in the steel and the yield of the concrete under continued load are considered in the formula. Concrete stress is increased as the amount of reinforcement is increased, and the spirals are based on the amount of vertical reinforcement. Provision is also made for long columns and composite columns with cast-iron and steel cores. Shearing stresses are higher in certain specific kinds of reinforcement. Bond and anchorage details are amplified, hooks are permitted, and anchorage effects evaluated. Flat-slab design follows the Westergaard and Slater analysis and approaches fairly closely the present Chicago rule. Some of the unit stresses are revised upward because more care in work is specified. For instance, flexure at center of a beam is specified at 0.4 the concrete unit strength at the center and 0.45 at the supports.

In conclusion, it was stated the committee submits this specification as a compromise agreement. It is noted that not every member agrees to every part of the report, but they all concur in its promulgation as the best compromise that can be reached.

Other Committee Work—Specifications or progress reports were presented by a large number of other committees, including the following subjects: Coal and coke, shipping containers, rubber products, textile materials, thermometers, petroleum products, electrical insulating materials, metallography, fireproofing, heat treatment of steel, road and paving materials, waterproofing materials, drain tile, magnetic properties of iron and steel, and malleable iron.

New President—F. M. Farmer, chief engineer of the Electrical Testing Laboratories, New York, was elected president of the society, in place of Guilliaem Aertsen, retiring president. J. H. Gibboney was elected vice-president.

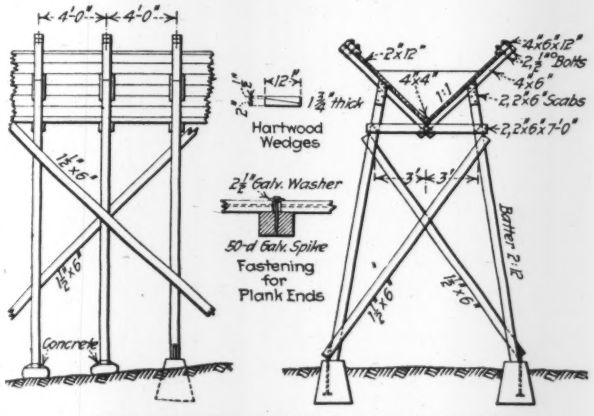
Irrigation Flume of V-Section Supplies Oregon Project

Wedging System Makes Nails Unnecessary To Hold Plank in Place—Only Standard Sizes of Lumber Used

THE SILVER LAKE Irrigation District, a recently constructed project in Lake County, Ore., which has several short flumes of practically standard wooden box construction, last year made an experiment with a 352-ft. length of V-section flume. This flume was built after a study of the good and bad points of the ordinary box flume and was planned in an attempt to find something better. It has now been in service through two irrigation seasons and is reported to have given entire satisfaction.

The reasoning of the engineers in selecting the V-section flume was as follows. The ordinary wooden box flume has been widely adopted for irrigation work as the type of flume whose first cost is lowest. Many irrigation projects which are remote from the ordinary markets but close to supplies of native timber find that the wooden box flume still figures the cheapest, even when maintenance and replacement costs over a long period are considered. The ordinary wooden box flume, however, has many disadvantages. Irrigation flumes are ordinarily dry during half the year, and the shrinkage, swelling and warping of the lumber makes it impossible to keep them tight. The resulting drippage softens the footings and much trouble and many failures of flumes arise from the foundations.

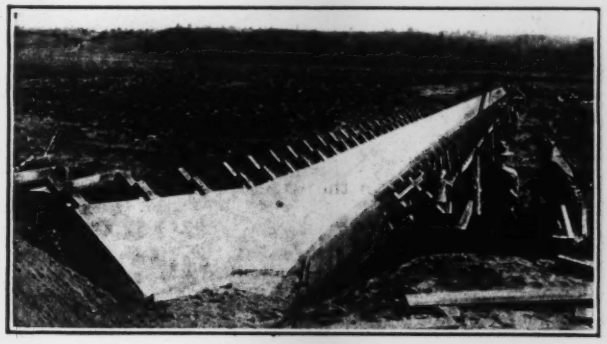
The difficulty of keeping the longitudinal joints tight



SIDE AND SECTIONAL VIEW OF FLUME

in a box flume is ascribed chiefly to the fact that the planks are nailed to the collars, and the collars or sills remain fixed while the planks vary in width as conditions change from dry to wet and vice versa. Splines and battens are not entirely satisfactory expedients in keeping these joints tight. In the semi-circular wood stave flume which has come into quite general use in recent years, the longitudinal joints are kept tight by the cinching effect of steel bands. The design of the V-section used on the Silver Lake project resulted from a desire to eliminate the nailing of the planks and to take advantage of the good features of the wood-stave flume, although using native lumber, locally cut, in stock sizes.

Flumes of V-section have been used extensively in the northwest for transporting logs but, so far as known, had not before been used for irrigation purposes. However, studies made for the Silver Lake district led to the conclusion that the V-flume has certain marked advantages over the ordinary square or box flume. The ordinary proportions of the box flume require a depth of water about one-half the width. If this proportion is adhered to, it was found that for the same perimeter the area and therefore the hydraulic radius of the V-section and the box flume are identical; hence for a given carrying capacity the amount of lumber in the V-section flume with sides at right angles is the same as in the box flume. The Silver Lake flume was comparatively small, having a capacity of 30



V-SHAPED FLUME FOR SILVER LAKE DISTRICT
Note bolted blocks and wedges on upper edge of top plank

sec.-ft. with a velocity of 5 ft. per second. The inside being smooth without battens was figured for a value of $n = 0.012$.

Design of V-Section Flume—The sides of the Silver Lake flume are made of 2x12-in. plank which meet at right angles and rest on a 4x4 on the center line of the structure. The planks are grooved on both edges and a ½x1-in. spline is inserted in this groove. The spline is made to have a rather easy fit, the idea being that with several angles for the water to go around, silt will quickly close the cracks and make them watertight. The planks are supported by 4x6-in. collars or cradles spaced 4 ft. on centers. On the higher portion of the flume these collars are supported on stringers, having a span of 16 ft. On the lower portions the collars are combined with bents which are spaced 4 ft. on centers. Footings are of two types, flat rocks for the lower bents and square concrete piers for the higher bents. The concrete piers which are provided for anchorage against wind have embedded steel straps spiked onto the base of the batter posts.

A feature of the design of this flume box is the method used to fasten the plank without the aid of nails. The collars have their ends extended beyond the sides, and a 4x6-in. block is bolted to the projecting upper end of each collar timber. Between this block and the upper plank, a pair of hardwood wedges is inserted and driven up tight, thus wedging all of the planks firmly in place. Except for this wedging the planks are not fastened to the collars at points between the ends. At the end a 50-penny spike is driven into the collar between the two abutting planks and a large washer under the nailhead serves to clamp both planks to the collar and still allow them to move under the action of the wedges. The primary purpose of this end nailing is to prevent the plank from coming loose and blowing off the trestle in the winter when the flume is dried out.

Advantages—A very important advantage of the V-section flume is the fact that any leakage runs to the bottom of the V and the drippage comes along a line midway between the footings. Being concentrated along a single line this drippage could, if desired, be picked up by secondary troughs and carried to convenient points away from the footings and substructure. Another advantage claimed for this flume is the ease of construction and excellent hydraulic qualities of the transitions. For transitions the two sides are simply flared out to a trapezoidal section which joins the canal with suitable headwalls.

In comparison with the ordinary square box flume it was found that the labor cost on the V-section was 15 per cent to 20 per cent more, due partly to the amount of framing required and partly to the inexperience of the average flume carpenter with this kind of work. It is believed that with a considerable amount of work to be done, the labor cost could be brought down to nearly the same amount as for a box flume. The material required is very little more than for a box flume; the hardwood wedges add a small amount to the cost.

The Silver Lake Irrigation Project was designed and built under the direction of Baar and Cunningham, consulting engineers, Portland, Ore.

Deep Canal Has Curious Effect on Salt Content of Shallow Lake

Salt Water Found to Travel More Quickly in Canal Than in Open Lake—Effect of This Movement Studied

ACTING upon the complaint of certain rice growers in that part of the Neches River valley, in Texas, lying between Beaumont and Port Arthur, the Corps of Engineers has conducted a study of the salt water content of Sabine Lake and its two principal tributaries, the Neches and Sabine Rivers.

Sabine Lake is a shallow land-locked body of water on the boundary between Texas and Louisiana, connected with the Gulf of Mexico by Sabine Pass. The United States Government has a system of improved waterways through Sabine Pass and Port Arthur canal to Port Arthur, and from Port Arthur through the Sabine-Neches canal to the mouth of the Neches River thence across the upper end of Sabine Lake up the Sabine River to Orange and to the intracoastal canal or up the Neches River to Beaumont. Port Arthur canal and the Sabine-Neches canal lie just inland along the shores of Sabine Lake. When these waterways were built a guard lock was installed in the Sabine-Neches canal near where it enters the Neches River. It was put in at the instigation of the rice growers along the river who depend on the river for irrigation water and who, at times of low flow, frequently pump more water from the tidal section of the river than is coming down from the headwaters. This action causes water to set back up the river from Sabine Lake and the rice growers feared that salt water would reach the river through the canal at times when the water in the upper end of the lake would otherwise still be fresh enough for their purposes. In their opinion the water in the lake remains sufficiently fresh to be used in the rice fields for a long time after the flow of the river drops below their requirements, thus providing a reservoir for them to draw upon.

When built, the guard lock was sufficiently large for the vessels using the canal, but recently, since larger vessels have been put into service, the lock has been found to be too narrow for practical purposes and as a result it is left open most of the time. The navigation interests claim that it has no effect upon the salinity of the Neches River.

In the years 1917 and 1918 the rice growers suffered from an excess of salt in the Neches River during the period of low flow and complained to the government concerning the open guard lock. This complaint resulted in the investigation, recently completed by the Corps of Engineers, as to the effect of the Sabine-Neches Canal upon the salinity of the water in the Neches River.

The district engineer finds that the extent of the salinity of Sabine Lake varies closely with the discharge of the Sabine and Neches Rivers. So long as this discharge is moderately high, the lake and connecting waters are free from salt. When, however, it falls to a low stage, salt water enters through Sabine Pass, and by the combined action of tidal flow, wind currents and salinity currents, is diffused through the entire lake. The district engineer's observations on this point disposed of the contention of the rice growers that the lake in its natural condition was a reservoir of fresh water, which during low stages of the river would remain uncontaminated for a long period. He found that the Port Arthur and Sabine-Neches canals with the guard lock open modified the natural diffusion of salt water in the lake, but with one exception these modifications were negligible.

The exception concerned the action of so-called salinity currents, which are currents set up due to the difference in specific gravity of salt and fresh water. When the two come together in a channel salt water moves upstream along the bottom, forcing the fresh water downstream along the top. This action is more pronounced in deep channels than in shallow. It follows, therefore, that when salt water makes its appearance in Sabine Pass, and when the discharges of the Sabine and Neches rivers are sufficiently low to permit it to enter, it will, through the action of the salinity currents, move up the canal more rapidly than up the more shallow lake. Given the conditions that Sabine Lake is comparatively fresh and that the river discharges are low, the existence of the open canal will result in the appearance of salt water at the mouth of the Neches at an earlier date than would occur were the canal closed by a guard lock. If the condition of low discharge continues it will be only a short time before the salt water will reach the mouth of the Neches River in its normal route through the lake. When this point is reached it is evident that the effect of the canal disappears. Therefore the practical utility of the guard lock is limited to its effect in delaying for a short time the arrival of salt water at the mouth of the Neches River in a period of low river discharge immediately following a period of high river discharge, when such period shall occur during a critical part of the rice irrigation season, which ordinarily extends from the first of May to the first of September.

From the available hydrographs of the Neches River over the past 18 years, the district engineer finds that in 7 years there will be one year where the river dis-

charge is low throughout the year; three years where the river discharge is high in the spring and early summer and does not fall to a very low point until the end of the pumping season; and three years when there will be a high spring and early summer discharge, followed by a low discharge before the end of the pumping season. In the first case, which, from the point of view of the rice growers, is the most serious, and which corresponds to those years (1917-18) regarding which the principal complaint has been made, the presence of a guard lock would be of no avail. Under such conditions the lake remains contaminated throughout the year, and the river receives as much salt water from the lake as it would from the canal even if the latter were opened. In the second case the guard lock is useless since the high discharges keep the canal, lake and river purified until the pumping season is past. In

SABINE LAKE AND CONNECTING WATERWAYS

the third case, however, there occurs the situation in which the guard lock is of practical value in retarding the incursion of salt for a period corresponding to the difference between the time required for the salt to pass up the lake or through the canal. The district engineer finds that this retardation, given an improved guard lock with two-way gates, would average about 8 days at Neches, 18 days at the McFaddin pumping plant and 26 days at Beaumont.

In view of the fact that only three large concerns are interested in rice growing along the Neches River and that two of these have their intakes above Beaumont where the effect of the guard lock is nil, and the fact that the other concerns will benefit from it only for a few days in a possible three years out of seven on the average, the chief of engineers has recommended that in the work of enlarging the Sabine-Neches canal the guard lock be eliminated. The district engineer estimates that a guard lock for the enlarged canal would cost $750,000 and the annual charge for depreciation and operation would be $40,000, a sum which the government would not be justified in spending for so limited a benefit.

Supreme Court Protects Water Users Against Overselling of Water

A DECISION just rendered by the U. S. Supreme Court in a case between the Idaho Irrigation Co. and water users under the ditches of that company declares that water users are entitled to protection against attempts by the irrigation company to sell water rights for more land than its supply can properly irrigate.

The Idaho Irrigation Co., a Carey Act company, was supposed to have an appropriation of 6,000 sec.-ft. of water, and contracted with the state of Idaho to reclaim about 167,000 acres. Later, the U. S. Department of the Interior fixed the area of the project at 117,677 acres, which area was patented to the state by the United States. It was later found, the water users claim, that the appropriated and available water was sufficient to irrigate only 40,939 acres. The irrigation company had sold water rights for 88,136 acres, but later bought back something over 12,000 acres of rights under foreclosure sale. The irrigation company claimed that the issuance of a patent by the Secretary of the Interior and the action of the state of Idaho in making application for such patent, on alleged proof that sufficient water was furnished to irrigate more than 100,000 acres, constituted proof that the claims of the plaintiff were erroneous and acted as a bar to the suit. The lower court, however, determined from evidence that the reasonable duty of water was 2¾ ft. for the whole area, without deduction for roads or other non-irrigable tracts, and accordingly found that the available water could not supply 50,000 acres of land. This finding, and the decision of the lower court that the irrigation company should be prevented from again selling the 12,000 acres of water right which it had bought back, were affirmed by the Appeals Court and have now been further affirmed by the federal Supreme Court.

The Supreme Court further upheld the district court on a point in which the Court of Appeals had overruled the lower court, namely, the question whether the irrigation company might still retain the water rights for some 5,000 acres which were owned by the company and trustees when the suit was commenced. The Supreme Court holds the injunction to be applicable equally to all the excess water rights in question, regardless of the claim that the 5,000 acres had water rights apportioned to them. It says, "The irrigation company, having oversold the available water supply, exclusive of the shares purchased at foreclosure sale, cannot be permitted to sell additional share, whether still unissued, or issued and sold but reacquired, and whether acquired before the suit and *lis pendens* or afterwards."

Denmark Loans Public Money to Aid Building

The acute housing shortage in Copenhagen and the provincial cities has made necessary during recent years the active assistance of the Danish Government. This assistance has taken the form of loans to builders at low rates of interest. Of the total of 47 million crowns authorized for this purpose, only 4 million crowns are left, and a request for an additional 20 million crowns has been presented to the Ministry of the Interior. It is thought that the Ministry will recommend that an additional 15 million crowns be granted.

Managing a Publicity Campaign for A Water-Works Bond Issue

How Wheeling, W. Va., Passed Two Million Dollar Issue—Organizations, Speeches, Literature and Exhibits—Opposition

By J. F. Laboon
The J. N. Chester Engineers, Pittsburgh, Pa.

EVEN IN these days of rapid advancement in all directions when everybody is an "engineer" of some kind or other, it is seldom that a water-works engineer nas the opportunity of managing a publicity campaign for a bond issue for municipal improvements. There is added interest in the instance at hand (a $2,000,000 bond issue for water-works at Wheeling, W. Va.) by virtue of the long-drawn-out affair that the water question had been (covering about two decades) and the fact that bonds for improvements had been previously voted down consistently every few years.

Numerous reports had been made by engineers and committees during this transition period, some recommending wells, some the Smith (Parkersburg) system and others filtration, but all without success, however, so far as providing the funds was concerned. The last three bond issues voted on were in the sums of $640,000, $1,620,000 and $2,000,000, given consecutively, the last figure being the amount of the successful issue under discussion. The writer's firm was commissioned to manage the bond campaign early in 1922. It was thoroughly realized that it would take more than a mere publicity campaign to carry the issue and it was felt at the start that the voters must be educated up to the needs of the improvements and the merits of filtration as against wells or the Smith system.

Securing Co-operation—To accomplish this the writer with the city manager, C. H. Dowler, presented the matter first to each of the local newspapers and made sure of their support and co-operation. Then to gain public confidence in the writer's firm and consequently in the publicity bureau directed by the writer, a committee of the Chamber of Commerce, consisting of an electrical engineer, a civil engineer, an architect and a building supply merchant, was organized to check the estimates of costs of the proposed improvements and thus the amount of the bond issue. This they did and their endorsement was published in the newspapers.

The Chamber of Commerce, the Rotary, Kiwanis and Lions Clubs, the labor organization, the Women Voters League, and all such public organizations were then given talks on the subject and their active support enlisted in the cause. Meetings were held in churches, synagogues, schools and homes to dispense information and solicit support. The Lions Club gave noonday talks on various street corners from a truck platform. Noonday talks were also made by the writer and the city manager with able assistance to the employees in various manufacturing plants throughout the city.

Literature—A pamphlet, entitled "Pure Water" containing facts as to the cost of the proposed improvements, the necessity of and reason for each individual item, the tax situation as affected by the bond issue, the saving in soap, labor, plumbing, bottled water, etc., to be accomplished with pure filtered water, the saving in insurance resulting from better fire protection, typhoid statistics, the question of revenues and rates now and after the improvements had been made, were put before the voters. Finally a humorous story supplied by the West Virginia State Department of Health concerning the migration of typhoid bacteria in the Ohio River was distributed in every home in Wheeling.

Pins with "Vote for Pure Water" printed on them were distributed by the thousands to the school children who were importuned to get their fathers, brothers and mothers interested in the matter and to vote for the measure. Streamers were provided automobiles to keep the subject alive in the minds of the people. During the last week of the six week's campaign, "Four-Minute Men" reinforced with lantern slides supplied by the State Department of Health depicting typhoid in its most horrible state and like related subjects were sent to every theater and movie in the city where a talk was given at every performance so that the public was not permitted to forget the topic.

Exhibits—Specimens of pipe removed from the distribution system to illustrate the effect of acid and turbid raw river waters, and of water backs and hot water piping to show incrustation caused by hard well water, were exhibited in two of the most prominent display windows on the main business street of the city. Pictures of the city reservoir in the process of cleaning showing the mud removal and actual samples of filtered and raw river waters were also displayed with appropriate comments. These displays were continued during the entire campaign period and attracted large crowds which often blocked the entire sidewalk. In the newspapers articles were run daily and Sunday.

Water at Polls—On voting day at every polling place in Wheeling a gallon sample of filtered water obtained from the Steubenville (Ohio) filtration plant was placed in contrast with a bottle of raw river water being supplied that day in Wheeling.

Notwithstanding the great preparation which had been made to inform and interest the public it was necessary to get the voters to the polls and this is where the women played a noble part. They provided conveyances in every voting district of the city to take the infirm, the housekeepers, and employees of different plants whose time was limited, to the polls to vote.

The bond issue carried by a majority of 3 to 1, thus voting the largest single municipal expenditure ever attempted in the state of West Virginia. It is also of interest to note that 10,224 votes were polled at this time whereas the greatest poll on the three previous occasions on which data are available was 5,010 in 1915. Others are 3,044 in 1914 and 3,294 in 1919. The general primary election for councilmen a year later showed a total of 10,466 votes which gives a fair comparison of the turnout effected in the bond campaign.

That all was not easy sailing during the campaign may be gathered from the fact that about 10,000 of the total population of 56,000 were being supplied filtered and well water by four private water utilities located in the suburbs. These people therefore could not have the interest in voting bonds for pure water that those who lived in the main city and were served untreated river water had, because of the increase in the tax levy which would follow the issuing of these bonds. A great number of these people who were being served hard well water were appealed to directly from the standpoint of comparative hardness of the well water and the Ohio River water filtered. Actual demonstrations were made before such audiences with standard soap solution to show the relative hardness.

Removal and Disposal of Air-Dried Sludge at Baltimore

Settling Tank Sludge Goes to Separate Digestion Tanks Thence to Drying Beds After Which Much of It Is Loaded on Farmers' Wagons Free of Charge

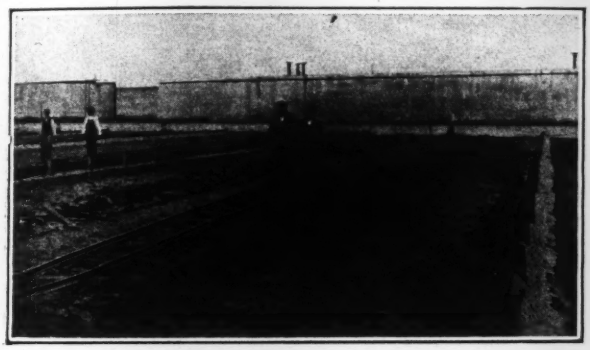
By John H. Gregory
Consulting Engineer; Professor of Civil and Sanitary Engineering, The Johns Hopkins University, Baltimore, Md.

and

C. E. Keefer
Engineer of Sewage Disposal, Sewer Division, Highways Department, Baltimore, Md.

ONE OF the most important problems with which the sewage-works operator has to deal is the disposal of sewage-sludge. In many instances this problem, though important, is not one of great concern. At Baltimore, however, where the quantity of sludge removed from the drying beds amounted to 24,600 cu.yd. in 1922, this matter is of great importance.

Method of Sludge Disposal Practiced—The sludge is collected in settling tanks, from which it is pumped into separate digestion tanks. After remaining in these tanks for a sufficient period to digest, it is drawn off onto sand beds to drain. This method of air-drying the sludge complies with the recommendations of the Board of Advisory Engineers, who stipulated that the sludge should be disposed of on "land in such a manner that its water is quickly reduced by evaporation and filtration and that the resulting fairly dry humus and mineral matter is inodorous and inoffensive." ("Report on the Disposal of the Sewage of the City of Baltimore" by Hering, Gray and Stearns, May 31, 1906.)



SHIFTING TRACK IN BALTIMORE SLUDGE BEDS
Before laying the track the sludge is removed where the track is to go.

In 1916—ten years later—when the Baltimore Sewerage Commission went out of office, and the work of sewering the city was continued by the Highways Department, 7.92 acres of sand beds had been constructed for air-drying the sludge. The area needed was based on the assumption that one square foot would provide for about three persons. It soon became apparent that the ratio above assumed was less than it should be. The experience of the past 12 years has demonstrated that from 0.8 to 0.9 sq.ft. per person is needed. Table I gives miscellaneous data with reference to the sludge-drying beds of several large American sewage-works.

Shortly after the Sewerage Commission went out of office, the building of additional sludge-drying beds was advocated but during the war no money was available for this work. This difficulty has since been overcome.

The program adopted will include building in the near future 180,000 sq.ft. of sludge-drying beds. Beds 5 and 6, covering an area of 100,000 sq.ft., or 2.3 acres, were completed in the latter part of 1923. With these beds in service there is a total area of 445,025 sq.ft. or 10.22 acres, used for drying sludge. This is by far the largest sludge-drying bed area in this country. Table II gives some data with reference to the beds built up to the present time at the Baltimore works.

LOADING SLUDGE INTO CARS FROM DRYING BEDS

Design of Sludge Beds 5 and 6—Sludge Beds 5 and 6 have been built in the vicinity of the other drying beds in order to concentrate the drying of the sludge in one locality. Each bed measures 125 x 400 ft. The two beds are separated by a level strip of ground 56 ft. wide, through which a driveway can be built in the future if desired. Each of the two beds is divided into 20 compartments 125 x 20 ft. Experience has demonstrated that when a length of about 125 ft. is exceeded that end of the bed farthest from the sludge inlet does not receive its proportionate quantity of sludge as the surface of the bed offers a considerable resistance to the flow of the sludge. For example, if sludge is 12 in. deep at the inlet end of one of the beds first constructed, which are 150 ft. long, it will often be found to be only about 8 in. deep at the other end. With beds 125 ft. long a more even distribution should be obtained.

As the result of experience in removing sludge and of much study, a width of about 20 ft. has been found, under Baltimore conditions, to be the most desirable for each compartment. With an industrial car 4 ft. wide, placed in the center of a compartment, the maximum distance that the sludge has to be thrown is about 8 ft. This distance is not too great when long-handled shovels are used. Such little saving as might have been gained from an operating standpoint by making the compartments narrower would have been offset by the added cost of more partitions, valves and piping.

The compartments are separated by precast reinforced-concrete partitions, 2 in. thick and 20 in. high, projecting above the sand 14½ in., and supported by precast concrete posts. With reinforced concrete at $41 per cubic yard and cypress at $140 per thousand board feet, 2-in. cypress planks would have cost little if any less than the material used. Concrete partitions will last much longer than wood.

The filtering material in the beds has a depth of from 12 in. at the side to 15 in. at the center and consists of ⅛- to 2½-in. gravel above which is 4 in. of

Table I—Design Elements of Sludge Drying Beds in Various Cities

No.	City	Population 1920	Total Area of Sludge Drying Beds, Sq. Ft.	Compartments in Beds: Number	Compartments in Beds: Length, Ft.	Compartments in Beds: Width, Ft.	Underdrains: Diameter, In.	Underdrains: Spacing C. to C. Ft.	Underdrains: Grade, Per Cent	Filtering Material: Character	Filtering Material: Thickness of Layers, In.	Character of Partitions	Method of Removing Sludge From Beds
1	Albany, N. Y.	113,344	66,560	32	104	20	3	13	1.0	Sand and gravel	¼ in. sand; 2 in. of ⅛ in. to ½ in., 4 in. of ½ in. to ¾ in.; 4 in. to 8 in. of 1 in. to 2½ in.	2-in. concrete partitions	By cars on industrial track
2	Alliance, Ohio	21,603	10,240	8	64	20	4 to 8	15	1.2	Sand, gravel and cinders	12 in. sand; 36 in. gravel or cinders	Concrete walls	By cars on industrial track
3	Atlanta, Ga. Proctor Creek	200,616	9,890	2	215	23	3	7	2.53	Sand and gravel	¼ in. sand; 2 in. of ⅛ in. to ½ in.; 5 in. of ½ in. to ¾ in.; 5 in. of 1 in. to 2½ in.	2 in. Y. P. partitions	By cars on raised industrial track
4	Atlanta, Ga. Peachtree Creek		19,350	5	172	22.5	3	7	0.96	Sand and gravel	¼ in. sand; 2 in. of ⅛ in. to ½ in.; 5 of ½ in. to ¾ in.; 5 in. of 1 in. to 2½ in.	2 in. Y. P. partitions	By cars on raised industrial track
5	Atlanta, Ga. Intrenchment Creek		19,350	5	172	22.5	4	7	0.96	Sand and gravel	¼ in. sand; 2 in. of ⅛ in. to ½ in.; 5 in. of ½ in. to ¾ in.; 5 in. of 1 in. to 2½ in.	2 in. Y. P. partitions	By cars on raised industrial track
6	Austin, Tex.	34,876	16,740	12	93	15	4	15	0.5	Sand and gravel	¼ in. sand; 2 in. of ⅛ in. to ½ in.; 4 in. of ½ in. to ¾ in.; 4 in. to 8 in. of 1 in. to 2½ in.	2-in. concrete partitions	By cars on industrial track
7	Baltimore, Md.	733,826[2]	530,000[7]	142	75, 100 125, 150	20, 26, 27.7 and 135	4	20, 25, 26 and 27.7	0.5 to 1.0	Sand and gravel	4 in. sand; 2 in. of ¼ in. to ¾ in.; 2 in. of ¾ in. to 1 in.; 4 in. to 7 in. of 1 in. to 2½ in.	Old beds, cypress; new beds, concrete partitions	By cars on industrial track
8	Batavia, N. Y.	13,541[1]	6,750	4	37½	45	3	7	1.0	Sand and stone	2 in. sand; 2 in. of ⅛ in. to ½ in.; 5 in. of ½ in. to ¾ in.; 7½ in. of 1 in. to 2½ in.	Concrete	Hand cleaning
9	Canton, Ohio	87,091	21,600[8]	6	150	24	6	30		Sand and gravel	15 in. sand; 6 in. gravel	Concrete	By cars on industrial track
10	Chicago, Ill. Calumet Plant	2,701,705[3]	71,680	60	66	12 ft.-5 in. to 20 ft.-3½ in. Most Are 17 ft.-7 in.	4	2 in each compartment	1.0	Sand, gravel and stone	1½ in. fine sand; 3 in. of ⅛ in. to ¼ in. Torpedo sand; 4 in. of ¼ in. to ½ in.; 3½ in. to 10½ in. of ½ in. to 2 in. stone	Concrete	By cars on industrial track
11	Columbus, Ohio	237,031	96,600	8	5@ 315 1@ 284 1@ 256 1@ 195	41.5	3	13.8	1.0	Sand and gravel	2 in. mortar sand; 2 in. of ⅛ in. to ½ in.; 2 in. of ¼ in. to ¾ in.; 3 in. to 7 in. of ¾ in. to 2 in.	2-in. concrete partitions	By cars on industrial track
12	Decatur, Ill.	43,818	40,000	16	100	25	4	12.5	1.0	Sand and gravel	1½ in. sand; 3 in. of ⅛ in. to ¼ in. Torpedo sand; 4 in. of ¼ in. to ½ in.; 3½ in. to 12½ in. of ½ in. to 2 in.	2-in. concrete partitions	By cars on industrial track
13	Fitchburg, Mass.	41,029	18,150	11	110	15	No underdrains used			Sand	6 in. layer applied to surface area	Treated wood	By cars on industrial track
14	Philadelphia, Pa.	1,823,779[4]	122,400	80	85	18	3	9.0	1.0	Sand and gravel	2 in. sand; 2 in. of ⅛ in. to ½ in.; 4 in. of ½ in. to ¾ in.; 4 in. to 7 in. of ¾ in. to 1½ in.	2-in. precast concrete	Hand cleaning to conveyor
15	Plainfield, N. J.	27,700[5]	13,440	5	84	32	3	10.0	1.0	Broken stone	5 in. of ½ in. to 1 in.; 3 in. to 10 in. of 1½ in.	Wood	Forked into manure spreader
16	Rochester, N. Y. Irondequoit Plant		76,640	40	44	44	3	8.0	2.08	Sand, gravel and stone	2 in. fine sand; 3 in. coarse sand; 8 in. sand and gravel; 6 in. broken stone	Concrete	Forked into cars, which are lifted by crane to main track
17	Rochester, N. Y. Brighton Plant	295,750	3,360	2	56	30	3	8.0	0.5	Sand, gravel and stone	2 in. fine sand; 4 in. sand and gravel; 6 in. broken stone	Concrete	Forked into wheelbarrows and loaded into wagons
18	Rochester, N. Y. Charlotte Plant		3,360	4	68 and 100	10	3	7.0	2.08	Sand, gravel and stone	4 in. sand; 4 in. sand and gravel; 6 in. broken stone	Concrete	Forked into wheelbarrows and loaded into wagons
19	Schenectady, N. Y.	88,723[6]	37,850	13	132 and 160	19	3, 6, and 8	6.0 and 19.0	1.0 and 1.4	Sand, gravel and broken stone	6 in. fine sand; 2 in. coarse sand; 3 in. of ¼ in. to ½ in.; 3 in. of ½ in. to 1 in.; 3 in. to 9 in. of 1 in. to 2½ in.	Treated wood	By cars on industrial track

Estimated population contributing to the sewage-works: [1] 15,000; [2] 590,000; [3] 125,000; [4] 300,000; [5] 38,000; [6] 65,000. [7] 90,000 sq.ft. of this area is now under contract. [8] Only 10-20 per cent of the sludge is dried on sludge beds.

Tables II, III and IV—Operating Data of Removal and Disposal of Air-Dried Sludge at Baltimore

TABLE II—DATA PERTAINING TO SLUDGE-DRYING BEDS AT BALTIMORE

Bed	Date Built	Source of Sludge Dried	Area Sq.Ft.	Area Acres	Cost	Cost per Acre
1	1909–10	Separate sludge-digestion tanks	45,100	1.04	$12,326	$11,852
2, 3 and 4	1914–15	Separate sludge-digestion tanks	180,400	4.14	23,015	4,460
4-A	1914–15	Imhoff tanks	44,525	1.02		
4-B	1915–16	Final settling tanks	75,000	1.72	8,297	5,831
5 and 6	1922–23	Separate sludge-digestion tanks	100,000	2.30	48,621	21,140

TABLE III—LOADS OF AIR-DRIED SLUDGE GIVEN TO FARMERS AT BALTIMORE FROM AUG. 15, 1922, TO MARCH 31, 1923

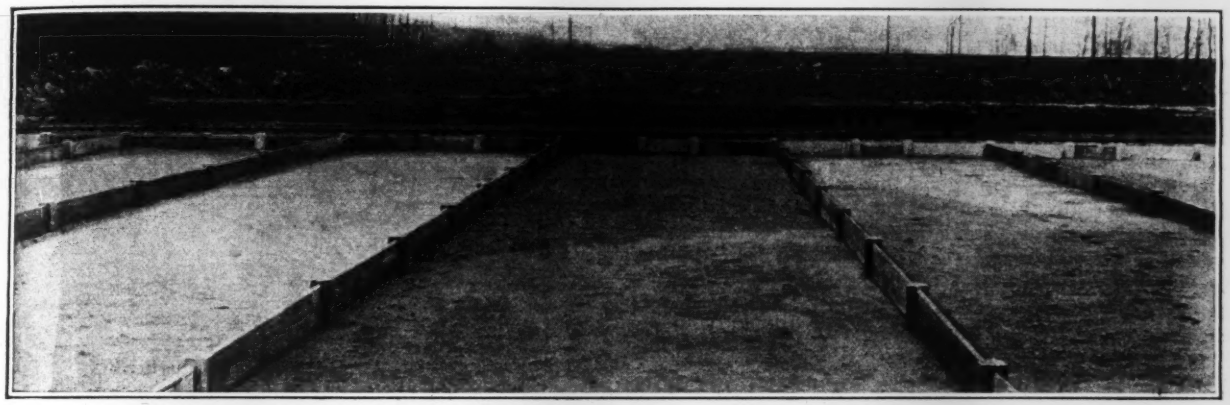
Date	Number of Loads	Date	Number of Loads
August 15-30, 1922	220	January 1923	850
September 1922	1,202	February 1923	650
October 1922	1,021	March 1923	274
November 1922	554	April 1923	199
December 1922	253		
		Total	5,223

TABLE IV—ESTIMATED COST OF BUILDING PERMANENT TRACK IN ONE COMPARTMENT OF BEDS 5 AND 6

24-in. track, steel ties	119 lin.ft.@ $0.94	$111.86
24-in. track, wooden ties	2 lin.ft.@ 1.58	3.16
24-in. curved track, wooden ties	20.8 lin.ft.@ 1.79	37.23
Single-throw switch		63.91
		$216.16
Deduct 24-in. track, wooden ties, in main line, occupied by switch	10 lin.ft @ $1.58	15.80
Total		$200.36

washed sand. A 4-in. glazed drain tile, surrounded by gravel, extends down the center of each bed, the tile being laid in a narrow trench with side slopes of 1½ to 1. The sides were not made vertical, as experience has shown, in beds that have been opened up, that with the continual passage of water through the bed a tendency exists to wash dirt down into the underdrains from the edge of the trench. Cleanouts have been provided at the ends of all underdrains so that a stream of water can be introduced into the drains to flush them.

Sludge is pumped to the beds through a 12-in. cast-iron force main. Connecting with this are short 10-cast-iron distributing pipes, one pipe to each two adjacent compartments, and in each of these pipes is a 10-in. single-seat gate valve, set to seat against the pressure. Adjacent to the beds is laid a 24-in., 20-lb. rail industrial track, and 1 cu.yd. side-dump cars, drawn



BALTIMORE SLUDGE-DRYING BEDS READY FOR USE

by a gasoline locomotive, are used in removing the dried sludge from the beds.

Portable Industrial Track To Be Used—Experience at Baltimore has indicated that it is not economical to construct permanent track in each compartment of the sludge beds. The only track used is that which is laid permanently outside of the beds, and enough portable track to lay in one compartment. When a bed is ready to be cleaned, a strip of sludge, about 4 ft. wide, is cleared away in the center of each compartment. This sludge is thrown to one side or the other and later is rehandled. A temporary track is then laid on the sand in this cleared space, and is connected to the main track by means of a switch.

In other works the practice has been almost universal to lay permanent tracks in the sludge-drying beds. Baltimore is one of the few places where this practice has not been followed. To determine whether the Baltimore method was an economical one, records were kept covering the cost of clearing away the sludge preparatory to laying the track, and the cost of laying and removing the track. These records covered the period from April 25 to Nov. 24, 1922, which practically coincided with the time when most of the sludge was removed during the year. Between these dates a total of 12,250 cu.yd. of sludge was removed. The sludge was cleared away in order to lay tracks 235 times, at a total cost of $721.34. As the length of track handled each time is 150 ft., the cost per linear foot of track per cleaning amount to 2.04c. The cost of moving all the portable track totaled $235, or 0.67c. per linear foot of track moved. For the period under consideration the rates of pay for the workmen employed were 60c. an hour for the foreman and from 37½ to 45c. per hour for laborers.

The estimated cost of building a permanent industrial track in one compartment of the recently constructed Beds 5 and 6 is indicated in Table IV, and is based partly on the prices bid for constructing these beds, and partly on quotations secured at the time the work was advertised.

With a charge of 5 per cent for interest on the investment and with an assumed depreciation and upkeep of 8¾ per cent, the total annual amount chargeable to each compartment of the sludge beds, if equipped with permanent industrial track, would be 13¾ per cent of $200.36 or $26.72.

If the beds are not equipped with permanent track, the cost of moving and laying track per compartment, together with the cost of cleaning away the sludge, would be $3.45 for each cleaning, as follows:

Clearing sludge for track	119	lin.ft.@2.04c	$2.43
Moving and laying track	151.8*	lin.ft.@0.67c	1.02
			$3.45

*119 + 2 + 20.8 + 7.5 + 2.5 = 151.8.

To this amount should be added the annual fixed charges (interest and depreciation) for portable track and one switch, which would be moved from one compartment to another, the cost of which is estimated as follows:

24-in. track, steel ties	121	lin.ft.@$0.69	$83.49
24-in. curved track, steel ties	20.8	lin.ft.@ 0.78	16.22
Switch			34.50
Delivery of above material			15.79
			$150.00

The fixed annual charge, assuming a 6-year life, may be taken at 5 + 16⅔ per cent or 21⅔ per cent of $150 or $32.50. As the track is moved approximately 360 times in one year, the fixed charge for each cleaning would then be 9 cents.

The annual fixed charge of equipping one compartment with permanent track, as shown above, would be $26.72. The annual cost of clearing sludge and moving and laying portable track per cleaning would be $3.45, and the annual fixed charge, $0.09, or a total of $3.54 per compartment per cleaning. It follows, then, that each compartment would have to be cleaned about 7½ times or more per year before it would be more economical to provide permanent tracks in the sludge beds at the Baltimore works. The

sludge was removed from the drying beds on an average of 3.75 times a year in 1915-20. In 1921 and 1922, basing the figures on only those beds used to dry the sludge from the separate digestion tanks, the averages were 3.02 and 5.46. At times the sludge has not always been thoroughly digested and hence the beds have not been cleaned as often as if fully digested sludge had been always handled, but should the time come when the beds can be cleaned as often as 7½ times a year permanent track can easily be installed.

It should be pointed out that in small works, where a sufficient force of laborers is not available, such as is needed for handling portable track, different conclusions might be reached.

Disposal of Air-Dried Sludge—Since the Baltimore works were first put in operation in 1911, air-dried sludge has been disposed of in three different ways: (1) As a base for fertilizer after heat-drying; (2) using it in fills; (3) turning it over to farmers. The present indications are that the most satisfactory of these three methods is to give it to farmers. The sewage-works are situated in the neighborhood of a large truck farming district, and the price of manure and fertilizer has been so high for the past few years that there has been little difficulty in disposing of the air-dried sludge.

One of the chief objections the farmers have had in the past to taking the sludge has been the difficulty in getting it because of inadequate roads at the sewage-works and also because they have objected to loading their own wagons. The first of these difficulties is being remedied. Over $28,000 is being spent on several concrete roads, which will total over a mile in length. The second difficulty has been met by hauling the sludge in cars onto an elevated trestle and dumping (a) directly into the trucks or (b) in a pile and then loading it into the farmers' vehicles by means of a caterpillar crane and clamshell bucket. The crane was put in service on Aug. 15, 1922, and has been used to a large extent since then.

Table III shows the quantity of sludge removed each month by the farmers from Aug. 15, 1922, to April 30, 1923. On the assumption that each load weighed 2.5 tons, the amount totaled about 13,060 tons. As the total quantity of sludge removed from all of the sludge beds during 1922 was 22,700 tons, it is possible that the farmers will be able to utilize the total output of sludge. During the year there are times when but little sludge will be taken away, particularly during the spring and summer months, but provision has been made to store the materials during such periods.

The farmers haul the sludge either in automobile trucks or horse-drawn wagons. The sludge is placed in piles on the fields and at a suitable time spread on the ground and plowed under. It is used as a fertilizer preparatory to the planting of a number of crops, such as potatoes, cabbage, spinach, tomatoes and kale. Some farmers haul the material as far as five miles. The general opinion among them is that the sludge is a satisfactory fertilizer.

Steuart Purcell is chief engineer of the Department of Public Improvements. The sewage-works are under the supervision of B. L. Crozier, highways engineer, with M. J. Ruark, division engineer of sewers, and J. W. Holden, superintendent of the works. One of the writers is engineer in charge of sewage-works operation and new construction and the other is serving as consulting engineer.

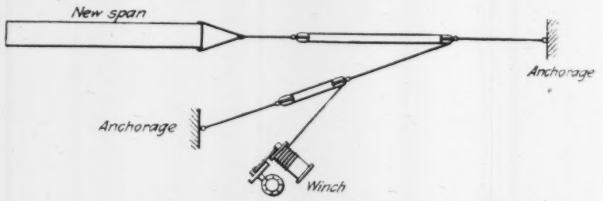
Erecting a Bridge in Palestine by Longitudinal Rolling

Steel Span of Yarmuk River Crossing Erected on Bank and Rolled To Place—Span Warped By Heating Effect of Sun

By P. W. Etkes
Assistant District Engineer, Public Works Department, Haifa, Palestine

WHILE the Allied forces under General Allenby were victoriously marching into Tiberias, the famous city of Galilee, the retreating Turks destroyed among a number of other things a railway bridge spanning the Yarmuk (a tributary of the Jordan) on the Haifa-Damascus Line. This bridge is situated some four kilometers from the southern end of the Lake of Galilee, 500 ft. below sea level. In restoring it for immediate service, the main span was made good by the erection of a timber trestle some 80 ft. high. In the course of time it became necessary to replace this trestle by a permanent span.

A new span, similar to the one destroyed was supplied by the Egyptian State Railways at a cost of some $40,000. The new structure, 165 ft. long and weighing 120 tons, was transported to the site in sections and erected on the west bank of the gorge about 650 ft. from the trestle. It was moved into place by longitudinal rolling, as described in the following:



ARRANGEMENT OF ROLLING TACKLE

Trucks and rollers were obtained from obsolete rolling stock. Three trucks were placed under each end of the span, and six 6-in. rollers under the horizontal portion of the lower chord. A steam winch mounted on the west bank and coupled to a ¾-in. steel cable passing over multiple pulleys was used as the motive power.

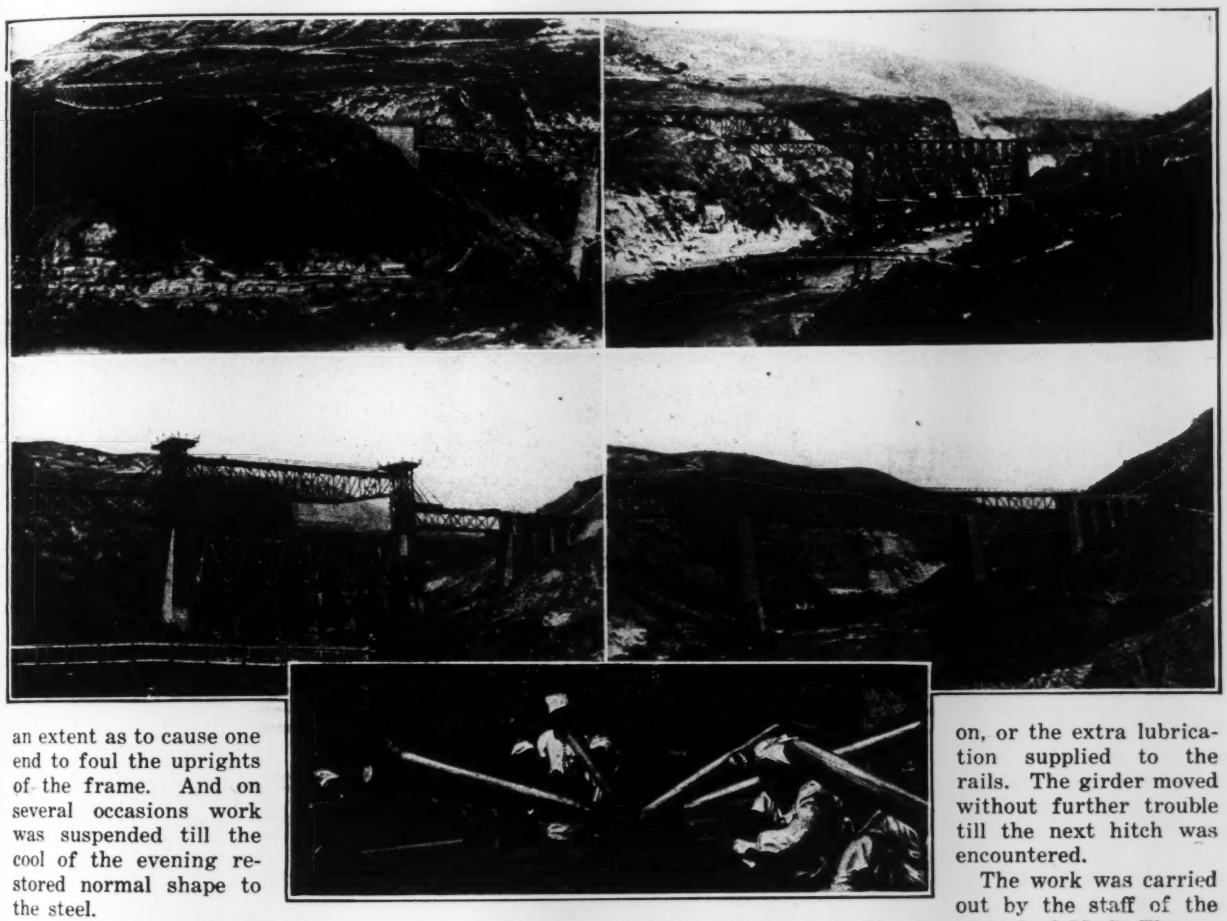
At the very outset difficulty was experienced on account of its being necessary to move the span along a curve. The trucks in taking the curve were not able to slide, due to the load on the blocking. This was overcome by jacking the rear end of the span sideways into alignment with the bridge. Forward movement was aided by the 0.5 per cent downward grade of the track toward the bridge.

When the span reached its position for lowering, timber frames were erected on the masonry piers to a height which enabled the girder to be attached by means of four gusset plates to the links of four lowering jacks mounted on the frames, 117 ft. above water level. With the aid of links, the jacks enabled the span to be lowered 22 ft. to the bearings without any further adjustment of the gantries. Since the lowering jacks were not capable of lifting, it became necessary during the adding or changing of links to support the girder on blocking; 50-ton hydraulic jacks lifted the

girder for removal of the blocking when the load was to be re-transferred to the links.

During the lowering of the girder, some difficulty was experienced owing to unequal expansion. In the hottest time of the day the two top chords and one of the bottom chords were exposed to the sun while the remaining chord, one side and the bottom bracing were in the shade. This caused the span to warp to such an extent as to cause one end to foul the uprights of the frame. And on several occasions work was suspended till the cool of the evening restored normal shape to the steel.

LONGITUDINAL ROLLING OF 165-FT. DECK SPAN OF YARMUK RIVER RAILWAY BRIDGE IN PALESTINE



R. F. Scrivener, acting chief engineer of the Palestine Railways, is of the opinion that on account of the girder having been suspended from the lowering jacks by means of gusset plates bolted to the ends of the top chords the stresses in the girder were reversed and helped cause the girder to warp.

During the whole period of work, traffic was as usual, and passengers (tourists) were taken over by a temporary footbridge. The total time required for the work was 48 days, of which 28 days were employed in moving the span into position and adjusting falsework and 11 days in setting the bearings, dismantling the gear, riveting up the bracing and making final adjustments. No night work was possible owing to the unskilled labor employed and the very high winds which blow up the gorge nightly during the summer months. Each night the girder was packed up and braced to prevent oscillation. Throughout the work considerable delay was experienced by heavy rains.

Native unskilled labor was employed on the work, except for the foreman and the winch driver. On one occasion when things were not moving smoothly a deputation of workmen requested permission of the resident engineer to sacrifice a sheep to propitiate Allah. The request was granted and a sheep was duly slain on the rails in front of the girder. The desired effect was achieved, whether by reason of the propitiation, work put in while the rites were being carried on, or the extra lubrication supplied to the rails. The girder moved without further trouble till the next hitch was encountered.

The work was carried out by the staff of the Palestine Railways under the control of M. S. Thompson, chief engineer, R. F. Scrivener, assistant chief engineer (now acting chief engineer), and F. H. Taylor, resident engineer in direct charge of the work.

Portable Outfit For Testing Aggregates

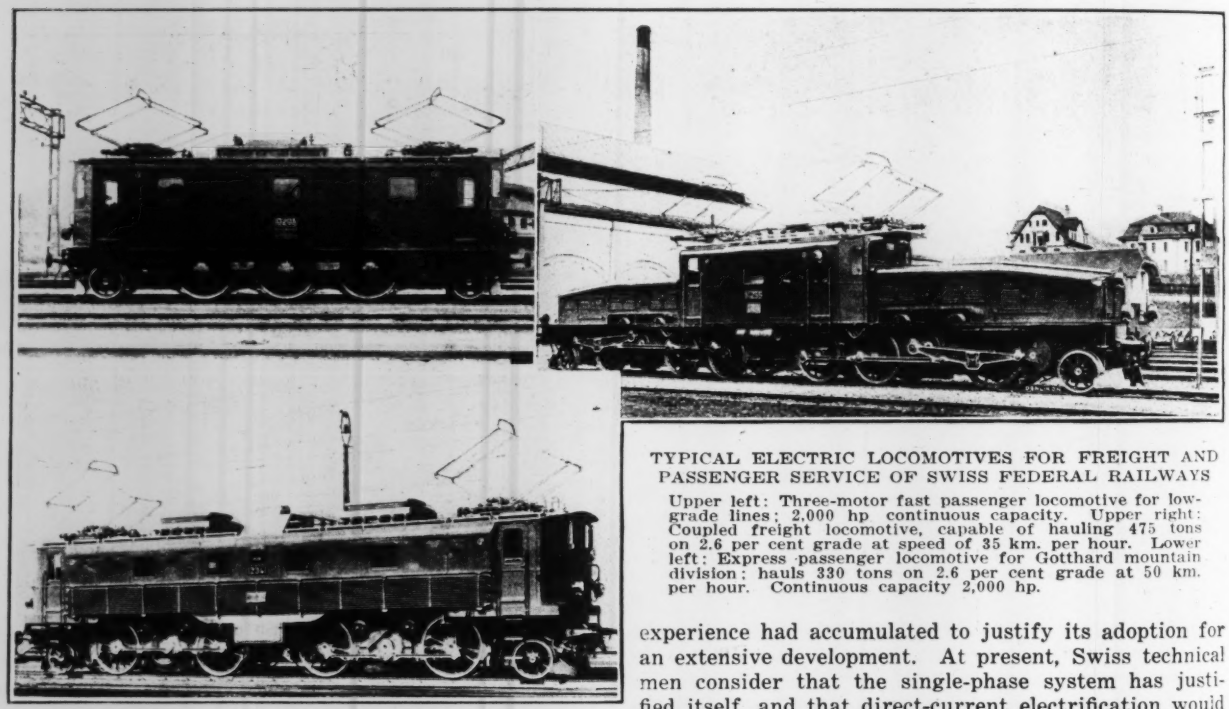
The Bureau of Public Roads has prepared and distributed to its materials engineers a number of portable testing outfits for use in the field examination of aggregates. Each outfit consists of a set of 8 half-cylindrical sieves and screens, ranging in size of opening from 100-mesh to 1-in. round; a 30-lb. spring scale for making mechanical analyses of coarse aggregate and other weight determinations; a 200-gm. spring balance for making mechanical analyses of concrete and asphalt sands; a portable stove for drying sand; a geologist's hammer; and bottles for silt and colorimetric determinations on concrete sand, etc. The equipment is contained in a small carrying case 18 in. long and weighs, together with the case, about 15 lb.

Railway Electrification Progress in Switzerland

More Than 400 Km. of Federal Lines Operating By Electric Power—Will Equip 1,150 Km. In Next Four Years

By Prof. A. Rohn
Zürich, Switzerland

ELECTRIFICATION of the Swiss Federal Railways is in full progress at present. Two factors mainly contributed to promoting this movement, the excessive coal prices prevailing toward the end of the war (which the foreign mining interests were able to exact because Switzerland lacks coal), going up to 220 fr. per ton, and the large amount of unemployment, which dictated the execution of public works as emergency enterprises. The following sketches the progress of the electrification movement.



TYPICAL ELECTRIC LOCOMOTIVES FOR FREIGHT AND PASSENGER SERVICE OF SWISS FEDERAL RAILWAYS

Upper left: Three-motor fast passenger locomotive for low-grade lines; 2,000 hp continuous capacity. Upper right: Coupled freight locomotive, capable of hauling 475 tons on 2.6 per cent grade at speed of 35 km. per hour. Lower left: Express passenger locomotive for Gotthard mountain division; hauls 330 tons on 2.6 per cent grade at 50 km. per hour. Continuous capacity 2,000 hp.

Careful analyses of cost indicate that as soon as railway traffic will have reached 90 per cent of its pre-war volume, electric traction will be as cheap as steam traction on the basis of a coal cost of 60 fr. per ton at the border. Any further increase of traffic will make electric operation cheaper. This cost comparison takes no account of the other advantages of electric operation, such as greater speed on grades and more rapid acceleration. The 250-km. stretch, Zürich-Chiasso, with 2½ per cent grade on the approach section of the Gotthard line, is now made in 4 hr. 37 min. by the fastest schedule train, against 5 hr. 19 min. under steam operation. For local passenger trains the respective figures are 7 hr. 14 min. and 8 hr. 30 min. A particular advantage is the materially faster acceleration of freight trains with electric power, leading to a reduction of running time that is of special value under the present conditions of reduced hours of labor and increased living cost.

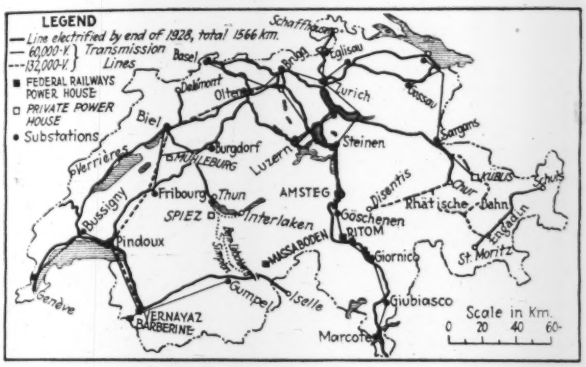
Because of the larger capacity of electric locomotives, heavier trains can be operated. On the approaches of the Gotthard line the most powerful steam locomotive handles 300-ton trains, whereas the new electric locomotives are able to haul trains of 430 tons, which is nearly 50 per cent greater. Increased speed, together with increased tractive power of the locomotives, also increases the traffic capacity of the line, which in turn postpones the need for additional trackage. The elimination of coal movements also increases the net traffic capacity of the trackage. Electric locomotives offer further advantages in their readiness for service and in the elimination of smoke—a feature of particular moment in mountain stretches with many tunnels and a heavy passenger traffic.

During the years 1913-1916 the choice of system was under sharp discussion. The final decision was in favor of single-phase alternating current, mainly because this system was the only one on which sufficient experience had accumulated to justify its adoption for an extensive development. At present, Swiss technical men consider that the single-phase system has justified itself, and that direct-current electrification would have proved to be more costly in construction and would have involved at least one-third more power consumption. While early in the era of electrification endeavors, in 1910, it was asserted in the course of discussions at the International Railway Congress in Berne that it would be necessary to seek international joint action on choice of system, opinion later changed to the view that in each instance the system should be adapted to the particular conditions of the railway network concerned; this opinion prevailed in the course of the last International Railway Congress, held at Rome.

At the present time alternating-current railway operation is standard in Norway, Sweden, Germany, Austria and Switzerland, and to some extent in England. The direct-current system has been adopted by France, Belgium, and Holland, and in part by England. Italy is the only country with three-phase traction.

State Power Supply—On the question of power supply, various reasons favor the establishment of federal

single-phase generating plants to supply the federal railways, in place of arranging for purchase of current from industrial and utility plants, which are generally three-phase 50-cycle. One of the reasons is the amount of power required; another is the nature of the Swiss electrical industry. The railways require all-year power, and in fact their winter demand is greater than the summer demand on account of electric heating, which amounts to 5 to 10 per cent of the power required for transportation. It is therefore just as feasible to build an independent set of single-phase plants in addition to the existing three-phase plants as it is to build all the plants to supply both kinds of service. However, with a view to smoothing out the peaks as much as possible the Federal Railways contemplate the construction of two transformer stations, of about 10,000 kw. capacity, which will permit taking over excess energy of the



SWISS RAILWAY ELECTRIFICATION BY 1928

About 400 km. of line of the Federal Railways are now operating by electric power. Within the next four years this will be increased to 1,560 km. (heavy lines on map). Several company railways are also operating electrically, chief among them the Bern-Lötschberg-Simplon line and the Rhätische Bahn, shown by dash lines.

industrial generating plants as well as delivering excess energy to them from the railway plants.

Electrification Program—In reference to the speeding up of electrification, it is to be remarked that the original program, of August, 1918, contemplated a period of 30 years for carrying out the electrification in its entirety; during the first ten years, a mileage of 100 to 110 km. was to be electrified each year, and later somewhat smaller mileages. After this program was adopted, however, conditions changed. Electrification costs today are still at a level of 70 to 80 per cent above those of 1913, but the price of coal is more than double that of 1913. Swiss industry at the present time continues to suffer from the uncertainty of world conditions, from fluctuation of exchange, and from the measures taken by most of the European states to protect their home production. Because of the resultant urgent demand for employment of industry, the electrification of the railways has been carried out without regard to the high price level.

Today 412 km. of the Federal Railway network are being operated electrically, and under the new accelerated electrification program it is expected that by 1928 about 1,150 km. additional will be electrified. By that time all the heavy-traffic government lines will be operating by electric power, and the supply network will have grown to such a size that the completion of electrification will be much simplified.

The total cost of the electrification of these 1,560 km. of railway line, excluding the cost of reinforcing and rebuilding bridges, will amount to 760,000,000 fr., comprising 520,000,000 fr. for fixed plant (power houses, substations, transmission lines, and roadbed equipment) and 240,000,000 fr. for rolling stock. This means an annual investment of about 75,000,000 fr. In addition, the reconstruction and reinforcement of bridges will require 3,800,000 fr. per year.

Power requirements for the full period mentioned (up to 1928) will be covered by the railway power houses on the Gotthard (the Amsteg and Ritom generating plants) and the two stations in Western Switzerland (Châtelard and Vernayaz) which latter two plants have an output capacity of 230,000,000 kw.-hr. at an investment cost of about 85,000,000 fr., thus representing very economical development for Swiss conditions. Any remaining power demand not supplied by these plants is to be taken from the private power network, until additional generating stations shall be built.

Of the total cost, about 25 per cent has gone into materials (purchased outside of the country), and 75 per cent into labor costs, general expense, and the like, which remains in the country. The railway electrification thus has proved to be a national undertaking benefiting all parts of the population. That this enterprise has been carried forward without interruption in the face of all the difficulties presented by present-day economic conditions represents a notable performance.

Boston Street and Highway Improvements

THE RECENT session of the Massachusetts Legislature authorized construction of what is known as the northern highway artery through Cambridge and Somerville at a cost of $2,400,000. Toward the cost the state will contribute $600,000, derived half each from motor-vehicle fees of 1925 and 1926. The remainder of the cost will be met by the municipalities benefited. The apportionment will be made by a special commission, to be named by the Supreme Judicial Court. The city of Boston was authorized by the legislature to widen Kneeland St. from Washington St. to Atlantic Ave. to a width of not less than 80 ft. at a cost of not more than $1,200,000, subject to the acceptance of the act by the city council prior to Dec. 31 of this year. The expenditure of the same amount was authorized for widening Tremont St. from Arlington Square to Stuart St.

A bill authorizing a $35,000,000 traffic artery through the city, beginning at Kneeland and Washington Sts. and extending by way of Whitmore St., Church Green, Fort Hill and other streets to Charles St., was referred by the legislature to a special commission consisting of the chairmen of the various city and district commissions, headed by the chairman of the commissioners of the planning division of the Metropolitan District Commission. Other street improvements will also be studied by the division. The division was authorized by the legislature to investigate and report upon a highway from Mattapan Square to connect with the main highway to the South Shore. Other bills passed by the legislature authorized the establishment of limited public ways in cities and towns and authorized the Division of Highways to make a study of the horsepower or carrying capacity of motor vehicles.

Lighting the Ideal Road Section of Lincoln Highway

Special Reflectors on High Poles Confine Light to Roadway—Cost per 4,000 Light-Hours 22c. per Foot of Road

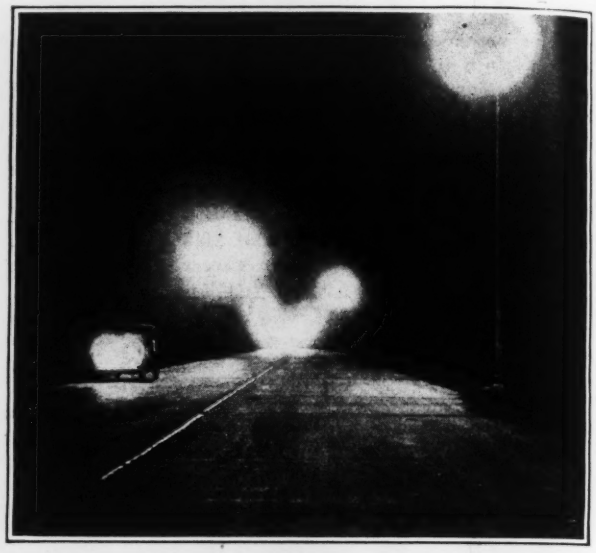
BY ITS EQUIPMENT for night travel the ideal section of the Lincoln Highway built in 1922 offers inspiration to highway engineers in greater measure perhaps than by any detail of pavement or roadway structure. The road is completely lighted. The highway illumination has been worked out as a problem separate and distinct from street lighting. This has not commonly been the case; ordinarily, street lighting methods have been extended out beyond city limits onto rural road prolongations of urban streets. The requirements in the two cases are unlike. On the rural road the range of desirable illumination is the width of the traveled way; a diffused and not a brilliant light is wanted and a light which is amply strong to temper the glare of undimmed headlights is essential. The close approach to these requirements is indicated by the night views presented. A description of the pavement structure, the light poles and the lighting device was published in *Engineering News-Record*, June 15, 1922, p. 982.

The lighting device adopted is the Novalux highway lighting unit of the General Electric Co., which consists of three nested parabolic reflectors, with an incandescent lamp within the reflectors. By this arrangement the greater part of the light that would be lost under ordinary conditions by being reflected upward, and outward to the adjoining fields, is collected and cast in both directions on the surface of the roadway. The rays that would escape if only one reflector were used are picked up by the inner reflectors and directed toward the roadway at an angle of 10 deg. below the horizontal. The white reflecting surfaces of the unit reduce the glare which would result if polished surfaces were used.

ILLUMINATION CLOSELY CONFINED TO ROADWAY

A 2500-lumen (250-candlepower) Mazda C series lamp is used, operating from a constant current circuit. By this arrangement, a maximum of more than 4,000 cp. is obtained from each end of the reflector from a lamp consuming only 153 watts. The entire unit is attached to the supporting pole by a bracket having a universal joint, which makes it possible to adjust the reflectors either horizontally or vertically, thus providing for the illumination of grades and curves. The unit provides for an even distribution of light; keeps the light out of the eyes of the driver; centralizes it on the surface of the roadway; and furnishes illumination of sufficient intensity to overcome the glare of the lights of approaching cars.

The units are attached to concrete poles, staggered and spaced at intervals of 250 ft. along the edges of the concrete, the light center of the lamp being 35 ft. above the roadway. The standards are of reddish brown concrete, and surmounted by simple bronze ornaments.



VISIBILITY DISTINCT A LONG DISTANCE AHEAD

The circuit from which the lamps are operated is installed underground, a single loop of cable being carried along one side of the road and brought back to the transformer on the other side. The cable is a steel-armored band and no conduit is necessary, except in the two places where it crosses the road, where it is installed in a 3-in. conduit, thus making it possible in case of accident to withdraw the cable without disturbing the surface of the highway. A constant current transformer is used, the primary supply being at 2,300 volts. It is entirely automatic in operation, and is controlled by a time oil switch. A series transformer is installed in the base of each standard.

As indicating the construction required for lighting, the following schedule of materials is interesting:

Concrete standards complete with brackets	28
Novalux Highway units	28
2,500-lumen (250-cp.) Mazda C series lamps	28
7.5-kw. Type R.O., constant current transformer	1
Type IL series transformers, 1.1 ratio	28
No. 8 B. & S. solid conductor, 4/32 in. R. C. rubber insulation, $\frac{1}{8}$ in. lead sheath, CLA1 finish, feet	16,000
No. 6 stranded duplex rubber-covered lead-encased cable for wiring from series transformer to fixture, inside of standard, feet	1,200
Time oil switch	1
3-in. conduit, feet	100

Current for the operation of the lamps is supplied from the Northern Indiana Gas & Electric Co.'s central station at Hammond, Ind., eleven miles away, the circuit being tapped a quarter of a mile from the western end of the section. The cost of operation is exceedingly moderate, the expense per year, based on 4,000 hours of operation, being only 22c. per linear foot of the section illuminated. The maintenance of the system, including inspection and cleaning and replacement of burned-out lamps, is in charge of the company furnishing the current.

Contractor Wins Suit to Recover Losses Due to Engineer's Misrepresentations

Holbrook, Cabot & Rollins Corporation Held Entitled to Rescind Contract to Build Passaic Valley Sewer Tunnel — Subsoil Data Wrongly Stated — Glacial Drift Reported as "Cemented Triassic Formation"

In this and the following article there are set forth details of two important lawsuits, recently decided, wherein heavy damages have been collected by contractors for improper—and the court says knowingly false—classification of subsoil materials. In either case the court has charged engineers employed by public bodies with deception, in one case even fraud. The Passaic Valley Sewerage Commission and the organization of the State Engineer of New York are involved. By the Passaic Valley decision, the contractor's right to rescind a contract in view of misrepresented data is upheld; both decisions uphold his right to reimbursement for extra cost. The opinions delivered emphasize the fact that results of subsurface investigations are material elements in the contracts.

IN AN IMPORTANT decision on the law of construction contracts the federal district court at Trenton, N. J., Judge Joseph F. Bodine presiding, has just awarded to the Holbrook, Cabot & Rollins Corporation damages in the sum of $816,600 against the Passaic Valley Sewerage Commission, for which the plaintiff had contracted to build some 6,000 ft. of tunnel in the outfall section of the Passaic Valley sewer. The contractor last summer rescinded the contract on the claim of misrepresentation in the contract drawings, and at the same time started suit to recover the unpaid balance of the cost of the work up to that time. The outcome of the suit upholds both the contractor's right to rescind and his right to be compensated for his expenditures; the jury allowed the full sum claimed. In charging the jury the judge laid down the doctrine that statements on the plans concerning subsoil conditions purporting to be based on borings or the work of prior contractors, constitute material elements in the contract between the two parties, and that if these statements misrepresent the facts known to the engineer the contractor is entitled to rescind.

Serious difficulties have surrounded the construction of the Passaic Valley outfall tunnel from the beginning. The work involved was the construction of about 15,000 ft. of tunnel, 11½ ft. inside of the concrete lining and about 15 ft. in diameter of excavation, constructed through rock and soft ground from a point near the east shore of Newark Bay, in Bayonne, N. J., to a terminal chamber nearly 2 miles out in New York Bay, about 400 ft. from Robbins Reef light. The work was first let in 1915 to the O'Rourke Engineering Construction Co., under a contract which contemplated doing the work in free air and provided for abandonment if the method did not prove suitable; the contractor accordingly abandoned the work after about two years. In 1917 the work was relet to Charles A. Haskin, who also abandoned work after about two years. It was let for the third time on May 1, 1922, to Holbrook, Cabot & Rollins Corporation, with about 6,000 ft. of the original 15,000 to be done, this length being in two separated sections of about 3,000 ft. each, extending from the terminal chamber westward to beyond Station 30, and from Station 60 to Station 90, both under New York Bay. The former section is in soft ground, the latter largely in rock. Both sections were excavated under compressed air, but without the use of a shield.

At the time of bidding and contracting for the work, the contractor says, he did not see the original boring report sheets (this was controverted). The tunnel was inaccessible, being full of water. The bid was made solely on the information supplied by the contract plans and boring samples (this also was disputed). These plans showed a number of borings, some of which were made before the first letting and some in the course of the first contract, when a change of method was under discussion; and information obtained by the actual excavation during the first two contracts. The level at which each hole encountered rock was given (whenever rock was reached) and the overlying strata were, generally speaking, described by the term "(cemented triassic formation)" with the elements composing this formation shown in most instances on the other side of the boring, such as "clay," "sand," etc. While the contractor was making up his bid, his representative went to the engineer and asked to see a sample of the material designated cemented triassic formation; he was shown a core of hard, rocklike substance. At the trial of the suit, however, the commissioner's engineer declared that "cemented triassic formation" denoted glacial drift.

After the contractor began work, he found divergence between the actual ground conditions and those he understood to be shown on the contract plans, sufficiently extensive to make the work quite different from that which he had contemplated, and much more costly. He therefore gave notice to the Passaic Valley Sewerage Commission early in 1923 that the conditions he found were not as represented, but that he would go on for a time in the hope that conditions would improve. At this time the terminal chamber was being constructed, and he stated that when he got to the bottom of the terminal shaft he believed a complete test of conditions would have been made. When the shaft reached the bottom he went to the attorney and chief engineer of the commission and said that he would stop work and would not proceed except on a cost basis. The commission declined to consider modifying the contract, however, and he thereupon rescinded the contract and entered suit.

It should be noted that the contract contained a very definite disclaimer of correctness of the information:

> The contractor shall take all responsibility for the work . . . shall bear all losses resulting to him . . . because the nature of the land in or on which the work is done is different from what was estimated or expected.

And the plans bore a note even more specific, thus:

> *Note*—The borings, soundings, contour lines, profile, and indications of rock outcroppings, subsurface materials, pipes and other underground structures are supposed to be approximately correct, but should they be found to be otherwise the contractor shall have no claim on that account, it being expressly understood that the commissioners do not warrant the plot to be approximately correct.

The charge of misrepresentation on which rescission

of the contract and claim for reimbursement were based involved a number of allegations, some of which are as follows: The term "cemented triassic formation" indicated to the bidder a consolidated and fairly tight material. No such material was found in the course of the work, and no such material was shown in the original boring records. A boring was omitted, the omission having the effect of showing conditions more favorable than would have been indicated by the omitted borings. The omitted boring stopped in soft ground when the casing broke, but the hole at that time was about 5 ft. lower down than the rock line in a nearby hole which was shown on the plans. The information given on the plans as to what the borings showed was in many instances quite different from what the original boring sheets showed. Some of the boring sheets also showed many alterations and interlineations, all of them of a character apparently to put a better aspect on conditions. In a large number of cases the original entries on the boring sheets, "red sand," "quicksand," and the like were changed to "clayey sand," "fine clayey sand," etc., these changes having been made by the engineers about two years after the borings were made and the boring sheets written up.

Occurrence of boulders was omitted from the contract plan data in a large number of cases; in a few instances boulders were shown, but in other instances they were omitted. In other instances certain essential items of information shown by the original records, as "stiff clay and boulders" were omitted, though the subsequent tunnel excavation confirmed the boring sheets as to the existence of such material. In a case of two closely adjacent holes the plans showed a rock line with conventional shading, a number of feet above the tunnel roof, though both borings were indicated as extending into the tunnel; the original boring sheets showed that in one of the two holes red sand extended to well below the tunnel roof, while in the other hole rock extended above the tunnel roof; the rock line on the drawings agreed approximately with the higher level of rock. In the case of a boring at the terminal chamber, the plans showed mud, gray sand, and red sand, with rock about 120 ft. below water (40 ft. below tunnel subgrade). In actually excavating the shaft, the contractor found quicksand, bull's liver, clay and boulders, and sand, gravel and boulders.

In explanation of the divergence between the contract plans and the original boring records, one of the engineers of the commission testified that different men had different terms for particular materials and that therefore in the preparation of the contract plans the terminology was unified. The term "cemented triassic formation," it was stated, was a heritage from the earliest days of the sewer enterprise, and was retained on this set of contract plans for the reason that it appeared on earlier sets. But on this last set of contract plans the term was placed in parenthesis, and certain descriptive terms were placed alongside or nearby, as "brown clay," "sand." The engineer claimed that the term "cemented triassic formation" together with these explanatory data, would describe glacial drift very well.

In the trial of the case, the questions of fact were placed before the jury, which was required to determine whether the contract plans misrepresented the facts known to the engineer or whether there was a mistake and whether the contractor relied upon these misrepresentations or the mistake in making up his bid. By finding for the contractor the jury answered one of these questions affirmatively but did not indicate which. The law of the case as bearing on mistake, misrepresentation and breach of warranty was discussed in the judge's charge, some parts of which are reproduced below:

It is the contention of the contractor that the contract drawings did not fairly disclose the conditions encountered by O'Rourke. . . . It is the contention, further, that the contract drawings do not fairly disclose the conditions encountered by Haskin . . . and that the test borings portrayed upon the contract drawings do not fairly disclose the conditions encountered at the time these borings were made. . . .

The language of the contract . . . and the statement on the contract drawings cannot relieve the commissioners of the duty to state with reasonable fairness the conditions known by them to have been encountered in the work done by the former contractors and with reasonable fairness to state the conditions encountered in the borings shown upon the contract drawings. . . . In making statements upon the contract drawings of material encountered by previous contractors, and in setting forth materials found in test borings, the commissioners were making positive assertions of fact upon which contractors were entitled to rely. . .

What are the alleged material misrepresentations of fact which the plaintiff says were deceptive? First, the term "cemented triassic formation" which appears in parentheses. . . . It is the contention of the plaintiff that these words "cemented triassic formation" as placed upon the contract drawings indicated to them and would indicate to a reasonably skilled engineer that there was a layer of material lying under the mud and sand of the river bottom extending to bed rock and through the line of the proposed tunnel. This material they say was indicated as cemented and more or less impervious to water. The defendant maintains that the words "cemented triassic formation" so appearing upon the contract drawings would not justify any reasonably skilled engineer in drawing such a conclusion and that the words are synonymous with glacial drift or glacial till; they do not indicate that there would be any such cemented material more or less impervious to water underlying the mud and sand of the river and lying as a blanket over, around and surrounding the course of the proposed tunnel. It is their contention, further, that Mr. Forgie, the engineer employed by the contractor, did not rely upon any such indications. . . . Gentlemen, it is a question for you to determine from all the evidence what the facts in the case are. . . .

The second general allegation of misrepresentation relates to conditions alleged to be disclosed at the terminal chamber within the vicinity of Boring 394, where the contract drawings show mud, gray sand, red sand and gray sand, the boring terminating in Hudson schist, at a considerable distance below the outfall tunnel. The witnesses called for the contractor . . . testified that at the terminal chamber there were encountered a large number of boulders, bull's liver, quicksand, not shown on the contract drawings. It is the contention of the commissioners that there was no representation as to what would be found at the terminal chamber; that such representations as were made were as to what was found in Boring 394. . . . It is the contention, however, of the plaintiff that the terminal chamber being sunk within the very location of Boring 394, although the fact is controverted, would necessitate the finding of the very materials disclosed upon the contract drawings if there was a full, fair and complete disclosure of the materials encountered at the time that Boring 394 was made. . . .

The contractor further claims that boulders were encountered by both contractors Haskin and O'Rourke, and that the boulders encountered by Haskin and O'Rourke are not shown upon that part of the tunnel excavation made by the previous contractors. The commissioners have introduced evidence to show that they did show boulders in eleven places during the course of the tunnel excavation; that boulders would always be expected in any excavation, and that it is not necessary for them to disclose every boulder. . . . .

. . . The law says that one who has been induced by

fraud to enter into a contract may rescind it. The law also says that where the contract has been entered into by reason of a mistake as to a material fact, the contract may be rescinded and recovery may be had by the party aggrieved for the reasonable value of the work and labor performed by him. "Every contracting party has an absolute right to rely on the express statement of an existing fact, and he is under no obligation to investigate a verified statement to the truth of which the other party to the contract, with full means and knowledge, has deliberately pledged its faith.

The plaintiff also says that in addition to the right to rescind because of the alleged fraud or the right to rescind because of the alleged mistake that it has the right to rescind because of the alleged breach of warranty. The big problem to which you must address yourselves is as to whether or not there was a material misstatement of fact. That is the problem. . . .

If there was no deceptive disclosure, if the commissioners reasonably and fairly stated the information within their knowledge both as to the test borings and the conditions encountered by the other contractors, that will be an end of your deliberations and the plaintiff will not be entitled to recover. But if, on the other hand, the disclosures upon the contract drawings were deceptive in any particular and of such a nature as to deceive a reasonably skilled engineer, and the commission failed to disclose the information as to soil conditions encountered by previous contractors and encountered in the test borings which was within its knowledge and which it could have disclosed had it exercised reasonable care in so doing, then you will be justified in finding that the disclosures of the contract drawings were deceptive, and if there be deceptive representations . . . it is immaterial whether those representations were made with a sinister purpose to deceive or not. . . .

Were the representations known to be false? The engineers of the commission have been upon the witness stand. They have told you how the test borings were made. The men who made the test borings were in court. They have told you how certain field notes were written up. They have told you as to how these field notes were rewritten after a study of the samples. . . . Mr. Taylor has told you that the term "cemented triassic formation" was a heritage handed down to him, the term having been used in various contract drawings which had been published running back to the original contract drawings which accompanied the contract between the municipalities and the Passaic Valley Sewerage Commissioners. He has told you that he placed the phrase in parentheses to indicate an explanation of that which had been particularly named on the other side of the borings shown upon the contract drawings. He understood the words "cemented triassic formation" to indicate material and diversified strata having its origin in the Triassic era, deposited by glacial action in various degrees of compactedness and hardness and containing varying degrees of clay and other materials. He knew it to be glacial drift, but he did not call it that on the contract drawings. He put it upon the contract drawings because it had been on other contract drawings. Were the drawings deceptive in this particular? Was there a deceptive representation as to the materials in these tests borings? Was there a deceptive representation as to materials encountered in the work done by other contractors? Was there a deceptive representation, and if there be, did the commissioners through their engineers know the falsity of such deceptive representations? . . . .

Mr. O'Rourke has been on the witness stand. He has told us that in a series of talks with Mr. Taylor, and Mr. Brown, a deceased engineer of the commission, during the progress of the work which he had done upon the tunnel and which you will see upon the contract drawings, the plans indicated to him that there was an overlying bed of cemented material overlying the tunnel, and he has told you how he told the engineers that it was a very nice position to put trusted contractors in who came to sink a caisson into hardpan and find that there was nothing but soft clay and unstable materials at the depth where hardpan was shown upon the drawings. He has told you how the engineers tried to cool him off by saying, "It will be all right, when you get down a little further you will get through." . . .

. . Mr. Forgie . . has gone into detail as to what he did prior to the securing of the contract by the plaintiff. . . He has told you how he called at the office of the commission and asked for a sample of the material which was designated as cemented triassic formation and how a portion of the material was shown to him and it was stated to him that it had been under water for twenty-four hours. He has told you what it looked like and he has told you that it was not here, although Mr. Taylor indicates the piece of material he says that he showed to Mr. Forgie. . . . It is for you to say from all the evidence in the case whether or no the plaintiff had knowledge of the falsity of the representations made. . . . Your next inquiry would be as to whether or no the commissioners intended, or at least had reason to expect, that the representations upon the contract drawings would be acted upon by prospective bidders. Forgie says that there was not time to make test borings and the making of test borings involves great expense. Were the contractors expected to make test borings? The borings were made by an independent contractor for use by the commissioners in procuring bids. Did the commission have reason to expect that the information would be acted upon by prospective contractors? It is for you to say from all the evidence. . . .

A mistake to warrant rescission of a contract must be material . . . and you must be satisfied that but for the mistake the contractor would not have assumed the obligation which he seeks to rescind. The mistake must not have arisen from negligence where means of knowledge were easily accessible. The plaintiff must have acted with the degree of diligence which must be fairly expected from a reasonable person. If, from all the evidence in the case, you cannot say that the contract was induced by fraud, can you say that it was induced by such a mistake as I have suggested? . . .

If the contractor establish his right to rescind because of fraud or because of mistake there can be recovery only if the right to rescind has been exercised within a reasonable time. What is a reasonable time necessarily depends on the circumstances of each particular case. It is settled that unless the situation of the other party has changed to his detriment the contract continues until the party defrauded elects to avoid it, and he may keep the question open as long as he does nothing to affirm the contract. . . .

[*The following are from the specific charges made on plaintiff's request.*—EDITOR.]

The defendant warranted to the plaintiff that the several materials, as described on the drawings and as coming from the several borings thereon, were in fact substantially the several materials which came from said borings. . . .

Even if the defendant placed upon the drawings the materials encountered in making the borings, it was not justified in describing or otherwise representing them as consolidated or bound together in a compact mass, unless that were the fact, and hence, even if materials such as sand, clay and gravel were found at the levels indicated, in any of the borings and were indicated upon the drawings as constituting the materials of which the cemented triassic formation was composed and were lacking such consolidation or did not consist of a cemented formation, and the jury shall so find, that constituted a misrepresentation and a breach of warranty. . . .

The jury has the right to infer that the contract drawings did not truthfully represent the materials actually found in the series of borings numbered 919 to 910, inclusive, from the fact that the original boring field notes for those borings were changed by the defendant or its agents by drawing a line through the names of certain of the materials entered on the original field notes, and substituting therefor the names or designations of other materials of a character substantially different therefrom and more favorable for tunneling than the ones for which they were substituted, and that such more favorable materials were placed upon the plaintiff's contract drawings or indicated thereon immediately overlying the tunnel as a representation to the plaintiff and other bidders that they truly represented the materials encountered by the previous contractor in that part of the structure completed between said series of borings. . . .

If the jury shall find that there was intentional omission by the defendant to place upon the contract drawings material information as to subsurface conditions, shown by the original field notes of the borings of the work to be done by the plaintiff, or that there was intentional omission of

material information as to the materials and conditions encountered by prior contractors that would indicate that the work would be substantially more expensive or more difficult than it would be as indicated by the representations on the drawings as to such work, then the jury has the right to infer and find that the defendant breached its contract or was guilty of fraud that would justify plaintiff in the rescission of the contract if plaintiff was misled thereby to its prejudice and damage. . . .

The plaintiff was under no obligation to make independent borings to ascertain subsurface conditions. . . .

The jury has a further right to find that the results of such investigation by the defendant in making the borings the defendant knew would or might be to protect itself against an extravagant price based on conjecture of conditions, and would also enable contractors to confidently bid upon ascertained and assured data furnished by the borings. . . .

When the plaintiff failed to find the materials excavated in the tunnel to be such as were described on the drawings to have come from the several borings, the plaintiff had the right, without waiving or losing its right to rescind the contract, to continue the work called for thereby until the the representations made in the drawings concerning the materials of the borings were in fact substantially true. . . .

[*The following is from the specific charges made on the defendant's request.*—EDITOR.]

The defendant, in placing the borings upon the contract drawings, and showing alongside of each boring certain materials, did not thereby make any representation as to the character of the subsoil along the tunnel line, or over it, or above it. The representation was that at the very points where the borings were made, the materials were found as stated. The fact that the plaintiff encountered different conditions in driving the tunnel than he expected is not in itself a justification in any way for his rescission.

The suit was prosecuted for the contractor by Conway, Kellogg & O'Brien, of New York, associated with whom were ex-Attorney General John W. Griggs and John W. Harding. The attorneys for the Passaic Valley Sewerage Commission were Riker & Riker, of Newark, N. J., with whom ex-Judge Alfred S. Skinner was associated.

William M. Brown was chief engineer of the Passaic Valley Sewerage Commission during the first and second contracts for the outfall tunnel. Since 1920 John R. Van Duyne has been chief engineer. William G. Taylor is deputy chief engineer.

Court Awards Contractor $400,000 for Engineers' Fraud

James Stewart & Co., Inc., Win Heavy Damages—New York Court of Claims in Its Findings of Fact Discloses "Falsification" of Barge Canal Plans

HOLDING that state engineers were guilty of fraud in presenting data on which the contract was let, the New York Court of Claims, in an opinion written by Presiding Judge Fred M. Ackerson, with Judge William B. Webb concurring, awarded James Stewart & Co., Inc., contractors, of New York City, damages exceeding $400,000 incurred in carrying out one of their contracts on the New York State Barge Canal. A dissenting opinion by Judge Sanford W. Smith denies fraud and disallows the major claim of $369,237 for damages. The case was decided last October.

On Feb. 21, 1910, proposals were asked for a canal in the Oswego River, between Three Rivers and Fulton, for a length of about 10.84 miles. During the 36 days elapsing between the date of the advertisement and March 29, 1910, the date of the opening of bids, detailed plans together with the state engineer's estimate of quantities and a composite unit price of 77c. per cubic yard therefor were exhibited to proposers.

On March 29, 1910, Alexander M. Stewart and James C. Stewart, co-partners in the firm of James Stewart & Co., submitted a proposal of 83c. per cubic yard for the item of excavation, which was practically the entire contract, and further itemized proposals for each of the other items. Upon this proposal the contract was awarded to the firm on April 15. Three years later the contract was assigned by the firm to the corporation of James Stewart & Co., Inc., with approval of the state. It was completed and formally accepted by the state in 1917.

It appears from the court's records that the firm protested when it found that the material excavated did not agree with that indicated by the maps of the state's engineers. Despite repeated protest it was instructed to finish the contract. The work took seven years instead of the three fixed by the contract.

In presenting its decision the court pointed out in its finding of fact that:

The state exhibited and furnished the detailed plans to proposers purporting to inform them to the fullest extent possible as to the nature of the material and the difficulty of excavation with the intent that proposers should rely thereupon and so that such proposers from the information there shown could submit an intelligent bid in reliance thereupon. . . .

The representations on the plans as to the nature and density of the material to be excavated other than rock were, in large part, false and misleading, and were made by the engineer who prepared the plans for the state for the purpose of deceiving the contractor as to the true nature of the materials to be excavated.

The court then gave a résumé of the information it finds to have been in the possession of the engineers of the state. It points out that 96 days were spent during 1904-5-6 in taking cross-sections and sub-surface investigations of the territory included in the contract and that during 1898, the U. S. Deep Waterway Survey spent 46 days doing the same thing and in recording the density of the materials and their difficulty of penetration. Copies of all these surveys and investigations were in the hands of the state engineers "during the preparation of the plans for the contract and although many of the soundings and borings were placed upon the plans none of the information thereon, except rock elevations, were placed thereon."

Commenting on the manner in which essential information was omitted from the map the court says:

The resident engineer who prepared the plans disregarded the state's record of the existence of "hardpan," "hard," and "very hard" material wherever it appeared in the state's records, almost without exception, and wilfully substituted for these three classifications of material upon the contract plans the words "clay, sand and gravel," or "sand," or some other modification of the same, thereby indicating material easier to excavate, or altogether omitted the same. The resident engineer wrote his superior, the special deputy state engineer, a communication accompanying the plans in which he described the materials in certain areas as of greater density than he had described the same on such plans. His superiors, despite the possession of this communication and other informa-

tion as to the density of the material, did not make appropriate corrections upon the plans.

The state's engineers after the plans were prepared dropped the grade line of the canal 1.2 ft. in certain areas for a distance of 47,000 lin.ft., thereby increasing the quantity of excavation in these areas, and at the same time wilfully and intentionally erased from the plans in certain of these areas notations of hard material, more particularly "hardpan" (five times), "very hard" (four times), "hard" (once), and "very" qualifying "hard" (once); and omitted from the plan the word "hard" appearing on the cross-sections twenty-five times in this area.

The resident engineer had described on sheet 6 of the contract plans and material overlying the rock as "fill material" when he knew the same to be a crib bolted together with rods and filled with rock.

Following its findings of fact, the court reviews in its opinion the legal aspect of the clause in the contract which disclaims responsibility for representations made, and the legal effect of the actual misrepresentations. Some passages from the opinion may be quoted:

Notwithstanding the plain provision of the statute which placed upon the state the responsibility of giving to the bidder an approximately accurate statement of the work to be done, the agents of the state sought to place upon the contractor the entire responsibility of determining at least the character of the material to be removed from the prism of the proposed canal. Then, in addition to this, the agents of the state limited the time in which the contractor should make this investigation to such an extent that it became totally and absolutely impossible for the contractor to make any such investigation. In addition, the contract provided in Section 10 thereof, in substance that the contractor would not make any claim against the state for any misrepresentation made by any agent or employee of the state concerning any of the work mentioned in the contract.

As the work progressed it was found that there was a wide variance between the materials actually met with . . . and the materials represented to be there. . . . But not until after the work was actually performed, and even after the commencement of the trial of this action for damages, was it discovered that these misrepresentations . . . were made by the agents and employees of the state with full knowledge of their falsity. . . .

It now clearly appears from the evidence in this case that the engineers of the state set forth information on the contract plans and specifications therein relating to the material to be excavated under the contract which they knew to be false when they placed it on such plans and specifications. It abundantly appears from the evidence that such engineers and agents of the state deliberately represented on said plans and specifications that the nature of the material to be excavated was much softer and easier of excavation than it actually was and than they knew it to be. . . .

These engineers in their zeal for rendering efficient service to the state undoubtedly satisfied themselves that such a performance on their part was justified in order to protect the state. But in law their acts constituted nothing less than fraud. . . .

The attorney general contends that clause 10 of the contract protects the state from damages and renders the claimant remediless. That clause reads as follows:

> The contractor agrees that he has satisfied himself by his own investigation and research regarding all the conditions affecting the work to be done and labor and material needed, and that his conclusion to execute this contract is based on such investigation and research, and not on the estimate of the quantities or other information prepared by the state engineer, and that he shall make no claim against the state because any of the estimates, tests or representations of any kind affecting the work made by any officer or agent of the state, may prove to be in any respect erroneous.

Representations known to be false when made and made with a purpose to deceive, as in this case, are not within the purview, scope, meaning or contemplation of Clause 10 of the contract. Such a clause could avail the state only in the case of erroneous information furnished by its agents through an honest mistake. Such a mistake consists in giving erroneous information which was intended and believed to be the truth by the one giving it. That, of course, is not this case.

The fraud of the agents of the state cannot, of course, be attributed to the state. . . . No damages in this case, therefore, for fraud nor of a punitive nature can be awarded against the state. Inasmuch as the representations from which the claimant suffered were fraudulent it is relieved from the obligation imposed upon it by Clause 10 not to make a claim against the state because of erroneous representations affecting the work made by any officer or agent of the state. . . . We reach the conclusion that the claimant is entitled not only to the contract price of 83c. per cubic yard, but in addition is entitled to recover the actual extra expense it was occasioned in doing the excavation work here by reason of the hard material it encountered not shown on the contract plans or known to the state to exist. . . .

In his dissenting opinion, Judge Smith holds that the demand of the invitation to bidders that intending bidders should investigate the site and examine the conditions for themselves, and the above cited Section 10 of the contract, nullifies any warranty that might be suggested by the notations on the plan. He therefore considers that there can have been no breach of warranty. As to fraud, he says:

There was no evidence of any character that the superintendent of public works or any member of the canal board, including the state engineer, had knowledge of any falsity in the plans or in any of the notations thereon as to materials to be excavated, or of intention on the part of any of them to deceive claimant. . . . In the view of the evidence most favorable to claimant, the most that can be said of it is that it would support findings that certain subordinates of the state engineer, namely, laborers in boring parties, did their work and recorded the results of their observations in an inefficient, careless, slipshod and inaccurate manner, that another subordinate, an assistant engineer, in an unwise, inexperienced, careless, and unwarranted manner misinterpreted some of the records of the boring parties, placing the results of his misinterpretations on the plans and omitting from the plans some of the information disclosed by the records of the boring parties, and that another subordinate, the special deputy state engineer, in good faith, approved the same and transmitted them so approved to the state engineer.

Judge Smith also holds that the assignment of the contract by the original firm to the corporation did not assign or transfer any claim upon the state, and that the corporation accepted the assignment of the contract with full knowledge (on the part of its officers) of the variance between plans and actual soil conditions, and therefore the corporation cannot claim it was deceived.

He also disagrees with the majority of the court in the matter of determining the amount of damages, in case damages should be found. He asserts that the governing principle of law is that the injured party in a case of deceit is entitled to be indemnified, excluding all elements of profit. He states that the proper method of computing the contractor's compensation in this case would accordingly be to determine the cost of the work to him, including all parts of the contract, instead of allowing the excess of cost merely on those sections of the contract which were concerned in the misrepresentations. He concludes:

The state is not chargeable with responsibility for fraudulent acts, concealment, representations or intent, by or on the part of members of boring parties or other subordinates of the state engineer and surveyor, if the state engineer and surveyor, members of the canal board and state superintendent of public works are without knowledge of the fraudulent act, concealment, representations and intent, and themselves act honestly and in good faith. Section 10 of the contract is a complete bar to the claim.

Novel Abutment Effects Economy In Concrete Bridge

Horizontal Thrust Taken by Wing Walls; Vertical Thrust Distributed Through Abutments Acting As Vertical Beam

BY ARTHUR G. HAYDEN
Senior Designing Engineer, Bronx Parkway Commission, Bronxville, N. Y.

PARK AVENUE bridge over the Bronx River Parkway Reservation near Tuckahoe, N. Y., illustrates a novel type of abutment for arch bridges.

The bridge consists of two stone-faced elliptical reinforced-concrete arches each 60 ft. clear span. The parkway drive passes under one arch and the Bronx River, which now flows through the Hodgman property, will, when diverted to this valley, flow under the other arch.

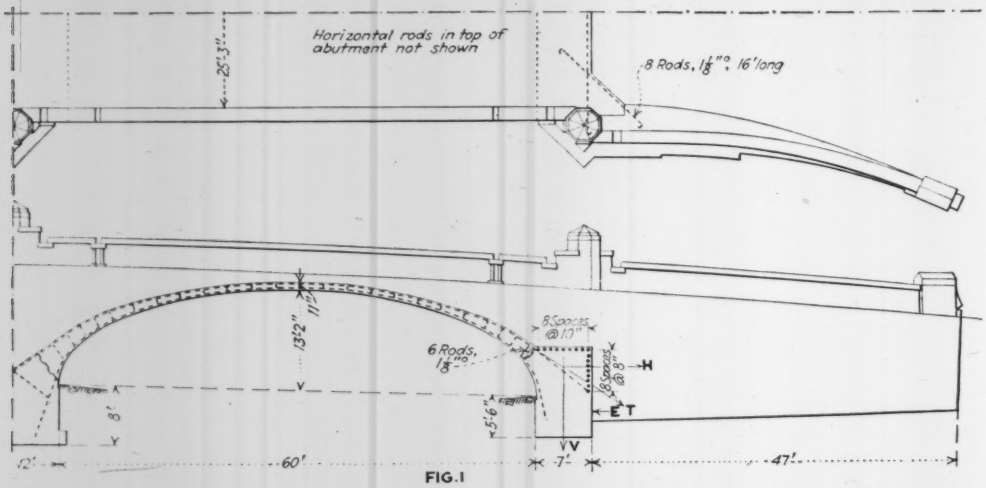


FIG. 1

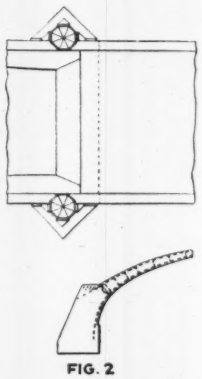


FIG. 2

FIGS. 1 AND 2—HALF PLAN AND ELEVATION OF PARK AVE. VIADUCT AND ALTERNATIVE DESIGN AT ABUTMENT

The bridge is being built by the city of Yonkers to accommodate traffic over the parkway, but the design was subject to the approval of the Parkway Commission. As a high standard of architectural beauty had been established by parkway bridges, architectural cheapness would not be tolerated in a right-of-way bridge crossing the parkway. On this account it was necessary to design a bridge that was structurally economical in order to keep down the cost and assure an appropriation.

The reinforced-concrete arch ring is 11 in. thick at the crown and is probably much lighter in section than is usual for like bridges subject to heavy traffic, except near the springing where maximum economy cannot be realized on account of the limitations imposed by the elliptical shape of the intrados. Further economy was realized by taking advantage of the long wing walls in the approaches, which were required for architectural appearance, to save in cost of abutments. The arch ring is designed to deliver the total thrust at the springline to the wing walls; at which point the thrust is resolved into horizontal and vertical components. The horizontal component is taken by the wing walls and dissipated into the ground foundation. The vertical component of the thrust if concentrated at the wing walls would result in excessive soil pressures at these points so the abutments are made to act as vertical beams to distribute the vertical load nearly uniformly over the entire area of their bases.

Ordinarily this would be the only function to be performed by this type of abutment. In this particular case the wing walls are not in line with the edges of the arch ring but are offset at the pylons so that the arch ring does not butt directly into the walls. Thus the abutment must act also as a horizontal beam to transfer the horizontal thrust to the walls and must therefore be wider at the top than would otherwise be necessary.

Referring to Fig. 1, the horizontal lines of rods in the tops of the abutments resist tension due to the action of the beams in distributing the vertical components of the arch thrust and the vertical lines of rods in the backs of the abutments resist tension due to the action of the beams in transferring the horizontal components from the corners of the arch ring to the ring walls. If the arch ring butted directly against the wing walls the design of the abutments could be as shown in Fig. 2. A tentative design for abutments of the conventional gravity type for this bridge was also made and the comparison with the adopted design showed that the latter effected a saving in cost of excavation and concrete for the two abutments amounting to $1,600. The scheme shown in Fig. 2, if it could have been used by avoiding the offset wing walls, would have permitted a further saving of about $1,000.

At first sight it might appear that the thrust for each foot width of arch should be resolved at the abutment into horizontal and vertical components; the vertical components going directly into the foundation and the horizontal components being carried by horizontal beam action of the abutments to the wing walls; but a little consideration will show that, on account of the extreme stiffness of the arch ring axially as compared to the stiffness of the horizontal beam, the conditions would not be as supposed. Without longitudinal slip-joints in the arch ring the abutments would not take off the thrust uniformly but nearly the total thrust would be delivered to points near the wing walls even though the abutments were designed to function otherwise.

The effect of earth pressure back of the abutments was considered in the actual design but the force due to this is not indicated in the figures.

The architectural design for Park Avenue viaduct was made by Bowdoin and Webster, architects, of New York City, and the structural design by the Parkway Commission's designing force under direction of the writer.

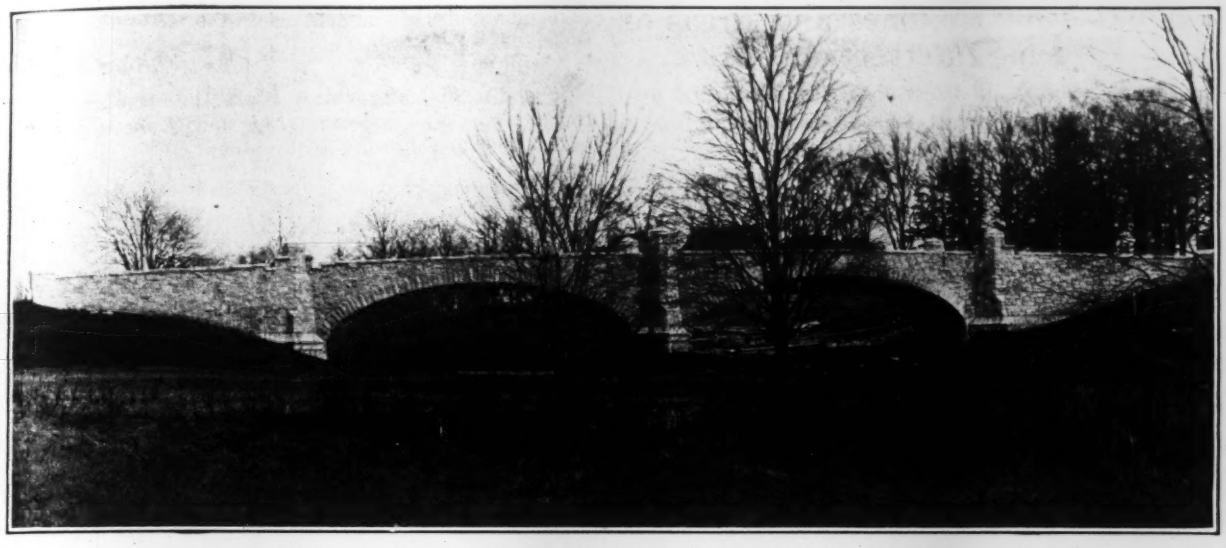


FIG. 3—PARK AVE. VIADUCT, COLONIAL HEIGHTS, YONKERS, N. Y.

The Parkway Commissioners are Madison Grout, William W. Niles and Frank H. Bethell; engineer and secretary, Jay Downer; deputy chief engineer, Leslie G. Holleran. The bridge was built by the Phoenix Construction Co. of New York.

The Park Avenue type of abutment has been used for one other parkway bridge.

What the Cook County Highway Traffic Survey Covers

First Comprehensive Study of Middle West Highway Traffic Into and Around a Large Metropolitan District

OBJECTIVES in the traffic survey of the highway system of Cook County, Illinois, undertaken by the Bureau of Public Roads in conjunction with the county are the solution of problems of (a) scientific and economical development of the highway system to serve traffic needs, (b) the relation of highway transportation to other forms of transportation, and (c) the influence of the city of Chicago on highway traffic in Cook County, and the establishment of fundamental highway traffic principles.

For this purpose traffic data will be taken leading to the establishment of principles in highway administration and highway engineering as follows:

1. Daily, hourly and yearly traffic flow and distribution.
2. Estimate of future traffic.
3. Quantitative determination of the relation of traffic to the economic factors producing traffic on the Cook County highways, such as population, production, wealth and motor vehicle registration.
4. Classification of Cook County highways as industrial, high-, medium- or low-type traffic routes based on (1) passenger car and motor truck density and (2) motor truck capacities, gross loads and wheel loads.
5. Motor truck frequency and gross tonnage per mile of highway.
6. The amount and frequency of motor truck overloading, front and rear axle load distribution, wheel loading, tire depth and tire impression under load.
7. Determination of the maximum loading and frequency of critical loads as an index of pavement width and design requirements of Cook County highways for the purpose of establishing highway traffic width and design factors for highways contiguous to large centers of population.
8. Relation between highway width, traffic density and speed.
9. Measure of the effect of congestion at intersections and "bottle necks" upon the rate of traffic flow.
10. An estimate of the extent to which the improvement of old or the opening of new traffic routes is economically justified.
11. Correlation of traffic loads and density on Cook County highways with highway construction and maintenance costs.
12. The type and volume of traffic on Cook County highways as an index to the allocation of highway construction and maintenance funds.
13. Comparison of the cost of various types of highway improvements such as relocations, grade reductions, elimination of grade crossings (both rail and highway) and elimination of traffic "bottle necks" with the estimated saving in transportation costs resulting from such improvements.
14. Comparison of the earning value of the Cook County highway system (based on passenger-miles and freight ton-miles) with the present worth of the Cook County highway system using replacement value minus depreciation as the basis of computing present worth.

Highway economic data will be collected and determinations made therefrom as follows:

1. Highway transportation information concerning the volume of tonnage shipped by motor trucks, marketing methods and the relation of highway transportation to other types of transportation.
2. Determination of the mileage zones of motor truck haulage and the relation of the type of commodity hauled to such zones.
3. The net tonnage of freight transported by regular and irregular trucking operators.
4. The situs of ownership of passenger cars and motor trucks operating over the Cook County highway system.
5. The actual or estimated value of motor truck net tonnage hauled over the Cook County highway system.
6. The type of origin and destination as well as the origin and destination of net tonnage of commodities transported by motor truck over the Cook County highway system.
7. The relation of motor truck transportation to other methods of transportation particularly as to competition, rates, operating schedules and delivery time in the short, middle-distance and long-haul mileage zones.
8. Haulage practices of motor truck operators and the volume of tonnage transported by motor truck between various cities and areas, as of value to governmental agencies charged with the regulation and control of highway transportation.
9. Passenger car business and non-business usage of Cook County highways.

Formulas for Volumes and Areas of Pipe Intersections

Elliptic Integrals in Formulas Are Simplified by Series Development—Tees, Manhole and Blowout Spurs Included

BY GEORGE PAASWELL
Structural Engineer, New York City

A MATHEMATICAL difficulty is encountered when the volume of cylinder intersections such as those at the junction of arches or in special pipe castings requires to be calculated. The following data cover the determination of these volumes. Three cases are covered: Case 1, general case of an eccentric spur from a main line, Fig. 1; Case 2, the case of a tee when the radii of stem and main line are equal, which is a special case of the former problem; and Case 3, the special case of a spur leading out of a tee, Fig. 2.

The determination is made by finding the volume of the opening made in one pipe by the other. It is then a simple problem to deduct this from the gross volume of the main-line pipe. A separate computation is made of the volume in the stem or spur.

The general solution by calculus involves the elliptic integral, and to avoid special tables the integrals have been evaluated in series, the terms being carried out far enough to accommodate the most refined work. In Case 2 the series converge slowly, and to avoid a large number of terms the elliptic integrals are left in the solution, but a direct algebraic method is given of computing these.

When the differential expressions for the several volumes are written, they may be integrated to the following forms:

CASE 1—The volume of the eccentric spur is

$$V_I = \pi M(r_1^2 - r_2^2) - \pi R_1[r_1^2 M_3 - r_2^2 M_1]$$

and the volume of the hole cut out of the main line by the spur is

$$V_{II} = \pi r_2^2 (R_1 M_1 - R_2 M_2)$$

The constants M in these expressions involve the offset ratios and diameter ratios $a/R_1 = t_1$, $a/R_2 = t_2$, $k_1 = r_1/R_1$, $k_2 = r_2/R_1$, $k_3 = r_2/R_2$, and are:

$$M_1 = \sqrt{1-t_1^2} - \frac{k_2^2}{8(1-t_1^2)^{3/2}} - \frac{k_2^4(1+4t_1^2)}{64(1-t_1^2)^{7/2}}$$

$$M_2 = \sqrt{1-t_2^2} - \frac{k_3^2}{8(1-t_2^2)^{3/2}} - \frac{k_3^4(1+4t_2^2)}{64(1-t_2^2)^{7/2}}$$

$$M_3 = \sqrt{1-t_1^2} - \frac{k_1^2}{8(1-t_1^2)^{3/2}} - \frac{k_1^4(1+4t_1^2)}{64(1-t_1^2)^{7/2}}$$

CASE 2—The volume of the spur of the tee is

$$V_{III} = \pi n(R_1^2 - R_2^2) - \frac{4R_1^3}{3}[2 - (1+j^2)E + (1-j^2)F]$$

and the volume of the hole cut out by the stem is

$$V_{IV} = \frac{4R_1^3}{3}[(1+j^2)E - (1-j^2)F] - \frac{8R_2^3}{3}$$

where j is the ratio R_2/R_1 and the quantities E and F are elliptic integrals which are computed as below.

CASE 3—The volume of the spur leading into the tee is

$$V_V = \pi s(r_1^2 - r_2^2) - R_1^3\left\{k_1^2(\pi I_1 + J_1) - k_2^2(\pi I_2 + J_2) - \frac{4}{3}(P_2 - P_1)\right\}$$

and the volume of the hole cut in the tee by the spur by

$$V_{VI} = r_2^2\left[\frac{\pi I_2 + J_2}{k_2} - \frac{\pi I_3 + J_3}{k_3}\right] - \frac{4}{3}(O_2 R_1^3 - Q_2 R_2^3)$$

Here the diameter ratios k are the same as defined for Case 1. The constants I, P and Q are to be computed by the following expressions:

$$I_1 = 1 - \frac{k_1^2}{8} - \frac{k_1^4}{64} - \frac{5k_1^6}{1024}; \quad J_1 = 1 + \frac{k_1^4}{96} + \frac{k_1^6}{192}$$

I_2, I_3, J_2 and J_3 similar but with the subscripts of k changed correspondingly;

$$P_1 = \left(1 - \frac{k_1^2}{2}\right)^{3/2}; \quad P_2 = \left(1 - \frac{k_2^2}{2}\right)^{3/2};$$

$$Q_2 = 1 - \left(1 - \frac{k_2^2}{2}\right)^{3/2}; \quad Q_3 = 1 - \left(1 - \frac{k_3^2}{2}\right)^{3/2}$$

Elliptic Integrals—The elliptic integral F may be found as follows. With the value $j = R_2/R_1$, compute q' from the expression

$$q' = \frac{1}{2}\,\frac{1-\sqrt{j}}{1+\sqrt{j}}$$

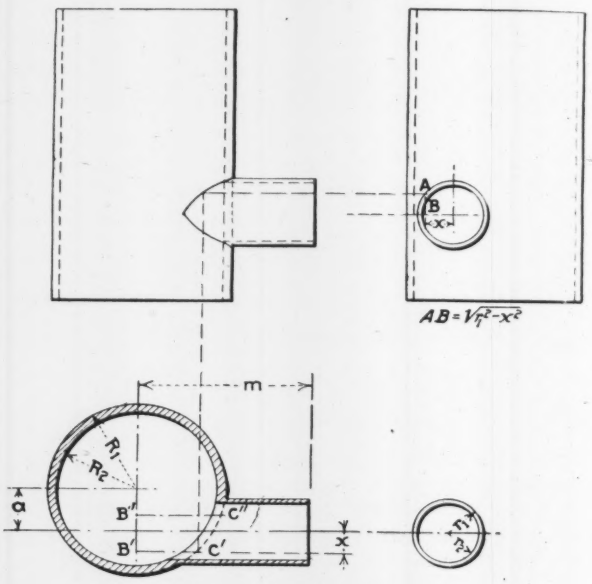


FIG. 1—SIMPLE SPUR, CASES 1 AND 2

then F is found from

$$F = 2.3026(1+2q')\log\left(\frac{1}{q'}\right)$$

Note, when using logarithmic computations, that the expression log $(1/q')$ is to be treated as any numerical quantity, and the logarithm of this logarithmic expression is taken from the ordinary tables.

The elliptic integral E may be found as follows. With the value $j' = \sqrt{1-j^2}$, compute q from the expression

$$q = \frac{1}{2}\,\frac{1-\sqrt{j'}}{1+\sqrt{j'}}$$

Then, taking the value of F found just above,

$$E = F - \frac{\pi}{2\sqrt{j'}}\left(\frac{2\pi}{F}\right)^{3/2} q(1-4q^3)$$

Numerical Example—As an example covering all three cases take the problem of computing the weight of the special casting made up of a 48x48-in. tee, with an 8-in. blowout and a 20-in. manhole as shown in Fig. 3. The blowout comes under Case 1, with inner

radius r_1 4 in. and outer radius r_2 5.25 in. The value of m is 28⅛ in., a is 20 in., R_1 is 26.17, R_2 is 24 in. The derived values are:

$t_1 = 0.7642$; $t_2 = 0.8333$; $k_1 = 0.2006$; $k_2 = 0.1528$; $k_3 = 0.1667$; $M_1 = 0.6334$; $M_2 = 0.5293$; $M_3 = 0.6244$

Then $V_I = 439$ cu.in., and $V_{II} = 195$ cu.in. or the net added volume due to the blowout spur is 244 cu.in.

The volume of the stem of the tee is found according to Case 2. The data and the derived values are:

$R_1 = 26.17$ in.; $R_2 = 24.00$ in.; $n = 37\frac{7}{16}$ in.;
$j = 0.9171$; $q' = 0.0108$; $\log\left(\frac{1}{q'}\right) = 1.9664$;
$F = 2.3628$; $j' = 0.3987$;
$E = 1.1517$ $q = 0.1129$;

With these values used in the volume formulas for Case 2 we obtain

$V_{III} = 6702$ cu.in., and $V_{IV} = 4827$ cu.in.

or the net added volume due to the stem of the tee is 1875 cu.in.

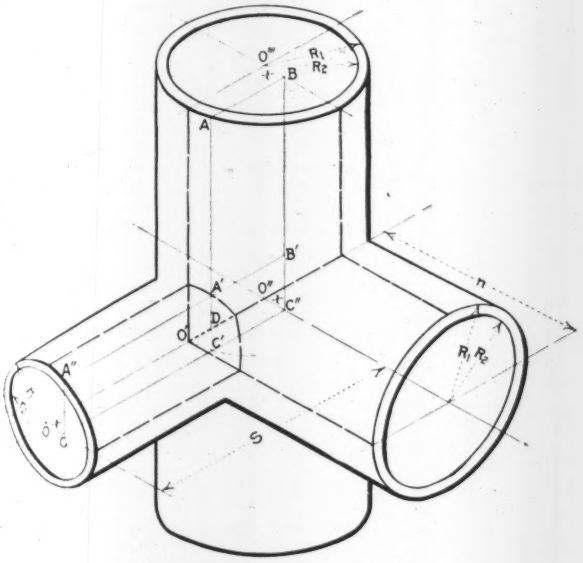


FIG. 2—SPUR ON TEE CASE 3

The manhole spur comes under Case 3, with data and derived values as follows:

$r_1 = 11.25$ in.; $r_2 = 10$ in.;
$R_1 = 26.17$ in.; $R_2 = 24$ in.;
$s = 29\frac{1}{4}$ in.; $k_1 = 0.4299$;
$k_2 = 0.3821$; $k_3 = 0.4167$;
$I_1 = 0.9764$; $J_1 = 1.0005$;
$P_1 = 0.8646$; $Q_2 = 0.1074$;
$I_2 = 0.9814$; $J_2 = 1.0002$;
$P_2 = 0.8926$; $Q_3 = 0.1273$;
$I_3 = 0.9778$; $J_3 = 1.0003$

These values inserted in the volume formulas give,

$V_V = 314$ cu.in., and $V_{VI} = 695$ cu.in.

so that the net volume addition of the manhole spur is negative and equal to 381 cu.in.

Summarizing then, there must be added to the volume of the main line pipe the three separate net additions of 244 cu.in., 1875 cu.in., and (negative) 381 cu.in., which makes the total addition 1738 cu.in.

Surface Problems—The area of the hole cut out of one cylinder by another one intersecting it eccentrically as shown in Fig. 1 may be computed by the expression

$$S = \pi r^2 M$$

in which, with the ratio of radii $k = r/R$ and the offset ratio $t = a/R$, the constant M is to be found from the first terms of a series formula

$$M = \frac{1}{\sqrt{1-t^2}} + \frac{k^2}{8}\frac{1+2t^2}{(1-t^2)^{5/2}} + \frac{k^4}{64}\frac{3-24t^2+8t^4}{(1-t^2)^{9/2}}$$

This formula is satisfactory for ratios of radii not

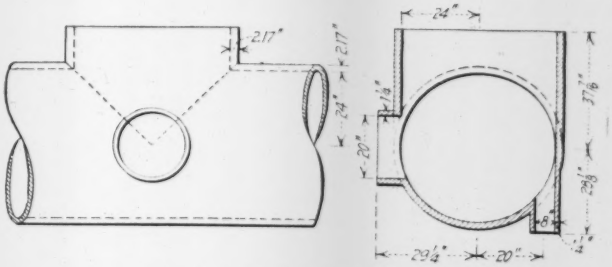


FIG. 3—A SPECIAL PIPE CASTING

greater than 0.5, but for larger ratios it converges too slowly and the three terms above included do not give the result with sufficient accuracy. For central intersection, as for a tee, the above formula for M becomes very simple, but as the ratio of radii is usually large in this case, up to a value of 1.0, a precise formula should be used (not applicable to eccentric spurs, however), as follows:

$$S = 4r^2\left[\left(1-\frac{1}{k^2}\right)F + \frac{1}{k^2}E\right]$$

where E and F are the elliptic integrals defined above, which may be calculated by using the value k in place of j. An interesting special result is that when the radii are equal the area of the hole is $4R^2$.

The shell area of the portion of the spur cut out between the main-line cylinder and the diametral plane is given by the expression

$$S = \pi RrN$$

in which

$$N = \sqrt{1-t^2} - \frac{k^2}{2}\frac{1}{(1-t^2)^{3/2}} - \frac{3k^4}{32}\frac{1+4t^2}{(1-t^2)^{7/2}}$$

This also gives accurate results only for small values of k. In the case of central intersection a formula suitable for all values of k is derivable, namely

$$S = 4RrE$$

where E is the elliptic integral already dealt with.

When the spur is central but intersects at an acute angle, the volumes and areas are equal to those computed for square intersection, divided by the sine of the angle of intersection.

The Fall in the St. Lawrence

In the editorial "Moving Forward on the St. Lawrence," *Engineering News-Record*, June 26, 1924, p. 1084, it was stated that the St. Lawrence fell "600 ft. from the lowest lake to the tide." This was a slip of the pen; it should have read "the highest lake to the tide." Lake Superior, the head of the Great Lakes, is about 602 ft. above mean tide.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

An Issue of $4,000,000 of Road Bonds for the completion of the Chef Menteur-Hammond highway in Louisiana is proposed in an amendment to the Louisiana state constitution recently submitted by Senator Davey, of Orleans Parish.

The Ontario Hydro-Electric Power Commission's annual report for the past year shows a revenue of $15,743,000 and a surplus of $346,000. The power output during the year increased from 566,000 to 685,000 hp. Capital invested by the Province of Ontario in this project is given as $241,853,000.

Construction of Approximately 500 miles of branch lines in the provinces of Saskatchewan and Alberta will be undertaken by the Canadian Pacific Ry. this year, it has been announced by D. C. Coleman, vice-president in charge of western lines. Considerable work has already been carried on.

Conflict Between the States of Illinois and private interests over the development of a power site of approximately 5,000 hp. at the mouth of the Fox River has been settled by the Federal Power Commission through a joint license issued to the state and to Fred D. Breit. Mr. Breit will construct and own the project and lease the state's property utilized under a provision which provides for recapture of the project by the state at the end of twenty years.

The Western Association of State Highway Officials comprising Montana, Colorado, New Mexico and states west will hold its annual meeting July 11 and 12 at Mammoth in Yellowstone Park. Howard C. Means, chief engineer, State Road Commission, Utah, is president. As many of the delegates will drive to the park as a part of their vacation, Z. E. Sevison, state highway engineer of Wyoming, is inviting them to the formal opening of the Wind River Canyon Road (See *Engineering News-Record*, June 7, 1923, p. 988).

By an Agreement Between representatives of the Chicago, Milwaukee & St. Paul R.R., the Chicago, Burlington & Quincy R.R., and the Davenport, Rock Island & Northwestern R.R., and the Municipal Levee Commission of Davenport, Iowa, the railroads agreed to complete by Oct. 10, 1930, the depression of the double tracks along the Iowa shore of the Mississippi River at an approximate cost of $300,000. They also agree to construct a new union passenger station at a cost of about $125,000. The foundations for this station were put in last fall and bids for the superstructure will be called for in the near future.

Derrick Mast Snaps, Sending Boom and Mast Through Hotel

Several persons were injured in New York City June 25, though none seriously, when the mast of a timber derrick snapped, letting the boom fall with its 5-ton load. The load consisted in half a dozen 10-in. short I-beams and some small channels. These, together with part of the boom, fell upon the roof of a five-story brick hotel building, the load breaking through to the ground floor. The accident happened on a steel frame building being erected on 36th St., near Seventh Ave.

Frederick C. Kuehnle, chief inspector of buildings of Manhattan, gave as the probable cause of the accident the fact that the guys holding the mast, which broke 4 ft. below its top, were too short, causing undue strain in the mast itself. The mast appeared to be in good condition, and the guys were well anchored and of heavy enough cable. Mr. Kuehnle said that the derrick was of strong enough construction to carry easily a load at least twice that under which the mast snapped. The guys were short of necessity, due to the fact that the building had but a 34 ft. frontage on 36th St., making the operating space for the derrick very limited.

The steel was being erected by the Paterson Bridge Co.

New York Speeds Road Work

Progress on new construction and reconstruction of state highways in New York State for the week ending June 27 shows 181 contracts under way with 7,112 persons employed by contractors. During the week 230,655 sq.yd. of pavement were completed, making a 1,008,773 sq.yd. the total completed during the season. The total maintenance force employed by the state is 4,844. These figures represent a total of 23.32 miles of completed pavement for the week and a total of 123.60 miles for the season.

Washington Conduit Breaks

Work on the new conduit being built between Great Falls and Washington, D. C., so exposed the foundation of the old 9-ft. brick conduit that 60 ft. of that structure went out during a recent heavy rain in the District of Columbia.

A serious possibility in connection with the accident was the fact that the consumption of water in the Capital during the summer is practically as great as the conduit's capacity. By working night and day a force under the direction of Major James A. O'Connor, the District engineer, was able to bridge the gap with a timber and concrete flume in 48 hours. The old conduit was built before the Civil War. It has a capacity of 65 m.g.d.

John H. Dunlap Injured in Train Wreck

Am. Soc. C. E. Secretary in Chicago Hospital—F. W. McNair, Head of Mines School, Killed

A rear-end collision between a standing passenger train and a fast mail train at Buda, Ill., at 4:40 a.m. June 30, resulted in the death of F. W. McNair, president of the Michigan School of Mines, and in the serious injury of John H. Dunlap, Secretary of the Am. Soc. C. E. Three other passengers and the fireman of the mail train were killed and many passengers were injured. Both trains were late. The passenger train had stopped for coal at Buda and was standing on a sharp curve where, according to the engineer of the mail train, the view of it was obscured by a west bound freight train. The engineer also claims that the direct rays of the sun prevented his seeing the automatic signal protecting the standing train.

The passengers who were killed and seriously injured were in the third car from the rear of the train, a sleeper which was sheared across the floor by the sleeper behind it. The engineers were returning from the convention of the society for the Promotion of Engineering Education at Boulder, Colo.

MR. DUNLAP TAKEN TO CHICAGO

Mr. Dunlap, who was injured about the spine, was taken to Chicago where an X-Ray examination revealed that his spine was not fractured. His condition is reported to be as satisfactory as could be expected under the circumstances.

He was taken to the Presbyterian Hospital.

Another engineer who was seriously injured was F. W. Ives of Ohio State University. Mr. Ives' back was broken. He had but recently been elected president of the American Society of Agricultural Engineers.

Mr. McNair was a graduate of the University of Wisconsin. After graduation he became an instructor in mathematics at that institution, later becoming assistant professor in the department of mathematics and civil engineering at the Michigan Agricultural College. In 1893 he went to the Michigan College of Mines as professor of mathematics and physics; he was elected president of that institution in 1899.

During the war Mr. McNair was in charge of cement testing and testing materials section of the U. S. Bureau of Standards. Subsequently he became consulting engineer physicist for the Bureau.

Other engineers on the train, but who escaped uninjured include C. J. Tilden, of Yale, and Col. Lincoln Bush of New York.

Am. Soc. C. E. Holds Annual Convention at Pasadena

Colorado River Problems and Sewage Disposal are Topics of Chief Interest: Many Attend

Engineering News-Record Staff Report

Although only nineteen of the twenty-eight directors attended the annual meeting of the American Society Civil Engineers at Pasadena, Calif., June 18-21, the general attendance was large: about 650 members and guests registered. The largest number were from California, of course, but it is notable that New York had the second largest representation and that some thirty states were on the registration list as well as members from points as far away as India.

Sandwiched in between attractive excursions, the technical sessions received appreciative attention; 520 attended the session on Colorado River problems alone. The Colorado was easily the outstanding subject before the convention and with discussion of Col. Kelly's paper, "The Colorado River Problem," by J. C. Allison, F. H. Fowler, Louis C. Hill, E. C. LaRue, Maj. H. S. Bennion, A. P. Davis and William Mulholland, power and irrigation needs in the Colorado River basin were presented from numerous angles. Differences of opinion were aired, as usual, this time quite vigorously in some instances, on preferable location, function, financing and control of the dam or dams that should be built first.

Discussion Is Lively

Those who discussed the paper might be classed as those who favored and those who opposed the Boulder Cañon project, but each speaker brought out distinctions or qualifying conditions so that there were really as many angles to the discussion as there were speakers. Some held that there was sufficient water, with proper regulation, for all needs; others pointed out that certain proposed developments would afford Mexico an opportunity to develop prior claim to low-flow water that would later be needed on the American side.

The Mojave reservoir was proposed as a project that would solve at once several of the more troublesome problems and was later vigorously decried as the revival of a scheme undesirable and ill-advised on many counts which was long ago abandoned as impracticable. Mr. Davis stated that the 160,000,000 cu.yd. of silt annually carried down by the river would be a serious factor in any project and a majority of the speakers mentioned the great importance of an agreement with Mexico before any extensive storage work was undertaken. The discussion was preliminary to a more complete presentation of views in "Proceedings," and the meeting adjourned without action favoring or disapproving any particular plan.

On June 19 simultaneous meetings of the power, sanitary, city planning, irrigation and highway divisions were held. The power group met at the California Institute of Technology where demonstrations were given in the million-volt transformer laboratory. The sanitary group, which had a very large attendance, discussed papers on the tri-cities activated-sludge plant and on the sewage-disposal scheme being worked out for the Los Angeles metropolitan district. The city planning group gave attention chiefly to streets and highways and the influence of motor transport on urban and interurban transportation. The irrigation division, being still young, held only a business meeting devoted to plans and objectives. The highway group discussed various angles of traffic development and kinds of road surfacing, in which engineers of the U. S. Bureau of Public Roads took a prominent part.

Excursions played a very prominent part in the convention, all were very well attended and showed evidence of careful planning and forethought. These included an evening trip to Mt. Lowe, with dinner on the mountain overlooking the valley and its lighted cities; a visit to a motion picture studio where movies were seen in the making; an all-day excursion to Catalina Island with its submarine gardens, and an all-day inspection trip to the points of chief engineering interest in the vicinity of Los Angeles. These, together with numerous shorter sightseeing trips and a garden party at the home of Mr. and Mrs. W. A. Brackenridge, afforded many members an opportunity to make the convention a real vacation.

New Board Takes Over Control of New York City Transit

Control of all new subway planning and construction in New York City passed, on July 1, from the state appointed Transit Commission to the newly created Board of Transportation, a board of three members appointed by the mayor of the city to serve for a term of six years. The Transit Commission will retain its regulatory powers over the companies engaged in rapid transit, over grade crossing elimination, facilities, and rates except that in the case of new lines of rapid transit constructed by the new board and operated by it the fare must be five cents for the first three years of operation; after that time the fare must be sufficient to make the lines self-supporting.

The new board takes over the engineering and construction staff of the Transit Commission.

License Issued for Power Plant in Northern Pennsylvania

The Federal Power Commission has issued a license to the Pennsylvania Power & Light Co. for the construction of a hydro-electric plant on Wallinpaupack Creek in northeastern Pennsylvania near Hawley. The plans call for a concrete dam 50 ft. high and 1,150 ft. long, a 14-ft. pipe line approximately 3 miles long and a power house on the Lackawaxen River with an installed capacity of about 50,000 hp. The reservoir to be formed at this site will have a capacity of 9,000,000,000 cu.ft. of water and will be an important element in the control of the flow of the Delaware River.

Report on St. Lawrence Expected in Fall

Department of Commerce Busy With Preparing Economic Data—Hoover Sees Development Certain

Washington Correspondence

No further development from the U. S. St. Lawrence Commission, named by President Coolidge to co-operate with a Canadian commission in revised studies of the cost and feasibility of navigation and hydro-electric works on the St. Lawrence River, may be expected until Fall.

Secretary of Commerce Hoover, who is chairman of this commission, expressed satisfaction with the results of the recent tour of the St. Lawrence, made by members of the American commission on his return to Washington. He stated that the tour had afforded the commissioners an excellent opportunity to visualize the problems and that the members of the engineering board, Gen. Jadwin, and Col. Kelly, had had opportunity to confer for eight days with members of the Canadian engineering board. The engineering advisers also have returned to Washington and will prepare their report on preliminary engineering data as soon as possible. Meanwhile a staff in the Department of Commerce is preparing economic data bearing on the situation. Until these data are received by the commission, it is not belived that any further step will be taken. The two reports may be expected sometime in September or early in October.

Speaking of the proposed developments in general, Secretary Hoover said that the entire matter is in an undeveloped stage and that what may be done remains for the future to decide. However, he renewed his previous prediction that development of the St. Lawrence River both as to use of its potential waterpower and as an outlet to the sea for deep-draft vessels is inevitable, the only question being the element of time when this development will be undertaken.

Tenant Collects Heavy Damages for Building Failure

Damages aggregating $97,014.75 have been awarded the Sidney B. Bowman Automobile Co. by the New York State Supreme Court as the result of the collapse on Dec. 1, 1920, of the Strathmore Apartments at 52d Street and Broadway, New York City. The verdict was directed against Walter J. Salmon, the Strathmore Leasing Co., the Longacre Building and Supply Co., Paul Chapman and Ferdinand Salmon, who were interested in the ownership or leasing of the building. The plaintiffs in the suit had a large stock of automobiles which were stored on the ground floor destroyed when the building collapsed.

A 30x30-ft. section of the nine-story apartment house collapsed while extensive reconstruction operations were under way. A full account of the collapse appeared in *Engineering News-Record*, issue of Dec. 9, 1920, page 1155.

War Department Approves River, Harbor Allotments

Total From 1925 Appriopriation Is $27,651,100—New York District Gets Unexpended Sums

Washington Correspondence

Allotments for river and harbor improvement from the War Department appropriation act for the fiscal year 1925 as suggested by Gen. Taylor, Chief of Engineers, have been approved by the Secretary of War.

The total allotments from the 1925 appropriation act aggregate $27,651,100, which leaves a balance of $9,598,900 for future assignment. The amount allotted is the minimum necessary for immediate use in order that work may be undertaken on approved projects throughout the country. In some cases the amounts are less than those stated in the annual report of the Chief of Engineers as those which could be used profitably during the fiscal year ending June 30, 1925, but they are regarded as sufficient to care for immediate needs. No allotments have been made for those projects which have been adopted subject to certain conditions of local co-operation, where those conditions have not been fully met.

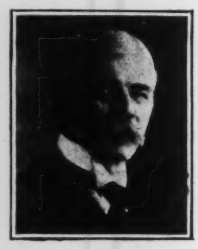
In addition to the allotments from the 1925 appropriation act, the Chief of Engineers also has allotted $2,569,800 which has remained unexpended from the 1924 appropriation. All of this latter sum will be spent in furthering work previously started in and around New York. East River is allotted $2,069,800; Hudson River Channel, $250,000, and New York Harbor, for work on the entrance channels, $250,000.

Allotments of $100,000 or more are:

Norwalk Harbor, Conn.	$139,000
Newark Bay, Hackensack and Passaic Rivers, N. J.	350,000
New York and New Jersey channels	1,400,000
Delaware River, Philadelphia to the sea	1,907,500
Wilmington Harbor, Del.	100,000
Inland waterway from Delaware River to Chesapeake Bay	850,000
Baltimore harbor and channels	350,000
Norfolk Harbor, Va.	157,400
Inland waterway from Norfolk to Beaufort Inlet, N. C.	371,500
Cape Fear River at and below Wilmington	300,000
Savannah harbor	694,000
St. Johns River, Fla., Jacksonville to the sea	775,250
Tampa harbor, Fla.	139,000
Mobile harbor, Ala.	181,000
Gulfport harbor and Ship Island Pass, Miss.	100,000
Southwest Pass, Mississippi River, La.	810,000
Sabine-Neches waterway, Texas	690,000
Galveston harbor, Texas	168,000
Galveston channel	300,000
Channel from Galveston harbor to Texas City, Texas	140,000
Houston ship channel, Texas	1,460,000
Mississippi River between Ohio and Missouri Rivers	700,000
Mississippi River between Missouri River and Minneapolis	1,050,000
Cumberland River above Nashville, Tenn	127,000
Missouri River, Kansas City to the mouth	1,050,000
Tennessee River below Riverton	148,750
Ohio River, lock and dam construction	3,545,400
Ohio River, open channel work	300,000
Monongahela River	1,400,000
Keweenaw waterway, Mich.	131,500
Fox River, Wis.	135,000
Milwaukee harbor, Wis.	600,000
Sandusky harbor, Ohio	100,000
San Francisco harbor	300,000
Oakland harbor, Calif.	245,000
San Pablo bay and Mare Island strait	200,000
Coos Bay, Ore.	663,000
Columbia and lower Willmette Rivers, Ore.-Wash.	637,600
Honolulu harbor, Hawaii	300,000
San Juan harbor, P.R.	120,000
Survey of northern and northwestern lakes	110,000
Supervision of New York harbor	150,000

Albert Carr

Albert Carr, the well-known rapid transit engineer, died at his home in East Orange, N. J., June 18; the cause was acidosis.



After graduation from Yale in 1883, Mr. Carr spent four years in general railroad practice, in 1887 becoming assistant engineer of the Brooklyn Elevated and Union Elevated Railroads in charge of foundations, track, iron erection, 36th St. terminal yards, litigation surveys and all field work including the construction of the Broadway cable road. In 1893 he was given charge of the construction of the Columbus Ave. cable road, Lexington Ave. and 116th Street underground electric in Manhattan and after 1895 of all field work connected with the Metropolitan Street Railway Co., including the construction of 75 miles of underground electric system.

In 1900 he became first division engineer of the Rapid Transit Commission in charge of subway construction between City Hall and 41st St.

The San Francisco earthquake disaster of 1906 made necessary the prompt reconstruction of the United Railways of that city, and Mr. Carr, as chief engineer and director of construction, achieved great success in solving the unique problem of a rush order for a complete new transit system for a great city. His next assignment was a dam, power house and allied works for the Colorado Power Co., after which he, with the late George S. Rice, made the necessary investigations and a report on the Lacroze subway project of Buenos Aires.

Since that time his work had been almost continually in New York City, for some years as technical counsel on litigation to the Interborough Rapid Transit Co.

During the War his time was devoted almost exclusively to the construction of army cantonments. During the last two years he has been engaged as chief engineer for the Powers Kennedy Corporation in charge of the Queensborough-Eighth Ave. extension under 42nd and 41st Streets.

Two Power Sites to Be Developed in Central Oregon

The Federal Power Commission has authorized the issuance of a license to the Columbia Valley Power Co. covering two hydro-electric power developments on the Deschutes River in Oregon. The Pelton site will be developed first and plans for it have been submitted to the Power Commission. They call for a dam 165 ft. high for the development of 51,000 hp. The Metolius site, which is 8 miles farther up the river, will be developed at a later date. The preliminary plans for this latter project call for a dam approximately 330 ft. high.

Long Beach City Engineer Found Guilty of Record Falsification

George S. Vanderwerken, city engineer of Long Beach, New York, was found guilty on June 25 of filing a false certificate in the Long Beach official records in order to cover up the loss to the city of $19,360. The verdict was returned in that part of the Supreme Court presided over by Justice James C. Cropsey and the conviction was the third one in a general criminal investigation of Long Beach officials, Mayor Willam H. Reynolds and City Treasurer John Gracy having previously been convicted. The jury in the case of Mr. Vanderwerken recommended clemency. The maximum penalty for his offense is one year in prison or $500 fine.

It was alleged that Mr. Vanderwerken certified that $19,360 was due Samuel Rosoff and Michael Dollard, contractors, for extra work which was never done. According to the prosecution, a certificate was filed to cover up the payment of the same amount of money to the contractors in connection with the $484,000 bond issue, misappropriation of part of which was the basis for the conviction of Reynolds and Gracy.

Detroit Engineers Endorse Cooley

In a recent meeting the Detroit Engineers passed a resolution endorsing the candidacy of Dean Mortimer E. Cooley as United States Senator from Michigan. In urging his candidacy upon the voters of the state, the resolution states: "By over forty years of service as an educator, by important parts played in his country's service in two wars, by a devotion to the interests and up building of the influence of the engineering profession unequaled by any other citizen, and by his efficient service as president of American Engineering Council, Dean Mortimer Elwin Cooley, of the college of engineering and architecture of the University of Michigan, has established a record for integrity, patriotism, good citizenship and ability in public affairs."

Road Bid Openings Broadcast

The radio has been pressed into service in the state of Missouri for the broadcasting of results in the opening of bids for road construction. The state capitol is the home of one of the most powerful of the United States broadcasting stations—WOS. A microphone is installed in the senate chamber where the bids are opened before the chief engineer and members of the highway commission. B. H. Piepmeier, chief engineer, reads the bids and bidders over twice and contractors from all over the Middle West have written in indicating that they have been able to tabulate bids from their own offices instead of traveling many miles to be present in person when the bids are opened.

Many letters have been received by the secretary of the Missouri State Highway Department in appreciation of this method of furnishing information on road lettings.

Modjeski and Masters Report on Harrisburg Bridge Reconstruction

Reporting on reconstruction of the Market St. bridge over the Susquehanna River at Harrisburg, Pa., Ralph Modjeski and Frank M. Masters, engineers, have recommended to the Harrisburg Bridge Co., owners, the construction of a stone-faced reinforced-concrete arch bridge over the east channel and removal of the steel girder spans now crossing this channel to a position alongside the existing spans over the west channel, thereby doubling the traffic capacity of the bridge. The existing structure is too narrow to accommodate the traffic.

The new bridge across the east channel is to have a clear roadway 40 ft. wide and two sidewalks 5 ft. wide, and is to consist of 16 spans 76½ ft. long in the clear, of segmental arch form, with a rise of 12 ft. 9 in. The width was determined by the decision that four lines of traffic should be accommodated, to permit the division of motor and horse-drawn traffic so that traffic can move over the structure with reasonable celerity. Estimates were made for a stone-faced concrete arch bridge, a concrete arch bridge without facing, and a steel girder bridge, the figures being (for the 16-span structure only) $923,000, $758,825, and $585,000, respectively. While the steel girder structure would be of lowest cost, its maintenance cost would be high, and its value would depreciate more rapidly than that of a stone-faced concrete bridge.

Upon the comparison of concrete and stone-faced construction, the report says of the bare concrete: "While in many cases the results thus far are satisfactory, there have been a number of cases where the concrete has been seriously damaged by ice gorges and the scouring action of sand and gravel. There have been also numerous cases where the surface of concrete has partly disintegrated in spite of very careful inspection during construction. For this reason we recommend that all parts of the bridge which may be subjected to damage from ice gorges, high waters and weather be faced with stone. The appearance of the stone-faced masonry is far superior to that of concrete."

Reprints of Mississippi Flood Protection Work Available

At the time of the record flood on the Mississippi River in May, 1922, *Engineering News-Record* reprinted an article on the flood protection work which was written by one of its editors who made a special trip along the Mississippi. A number of the photographic inserts are still available upon application and the enclosure of two cents in postage. The reprint contains eleven striking photographs of brush mattress work, stopping sand boils with sand bags and by other means, and general protection work along the levee in various places. Reprints will be mailed immediately upon application to the editor of *Engineering News-Record*, 10th Ave. and 36th St., New York City.

Plan New Lake Tunnel for Chicago

Another intake crib for the Chicago water supply system plus additional tunnels to shore and inshore for 3 miles to a future pumping station on the western border of the city are contemplated in plans under consideration by John Ericson, city engineer. The tunnels and crib are estimated to cost $8,726,300. The plan was induced by construction difficulties encountered in attempting to enlarge the ports in the existing Carter Harrison crib from which a tunnel was to run to the Two Mile Crib, the latter being so close to shore that its abandonment is desirable. The largest section in the proposed tunnel system is 16 ft. in diameter. Another reason for proposing the inshore tunnel is to furnish the Twenty-second St. and Springfield Ave. stations with additional water.

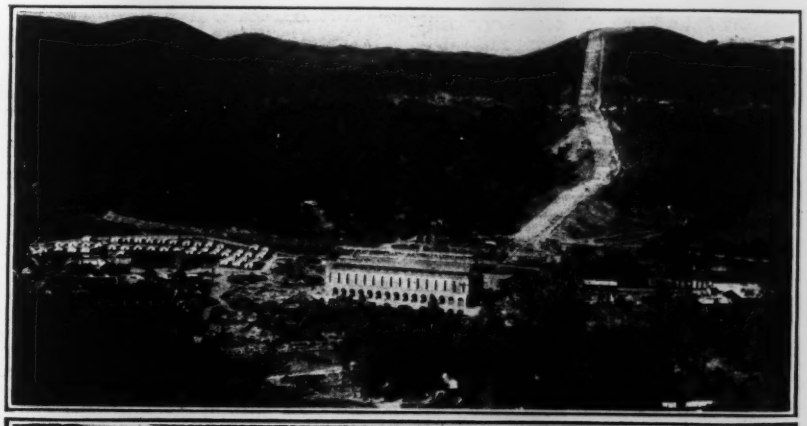
Portland Honors J. H. Polhemus

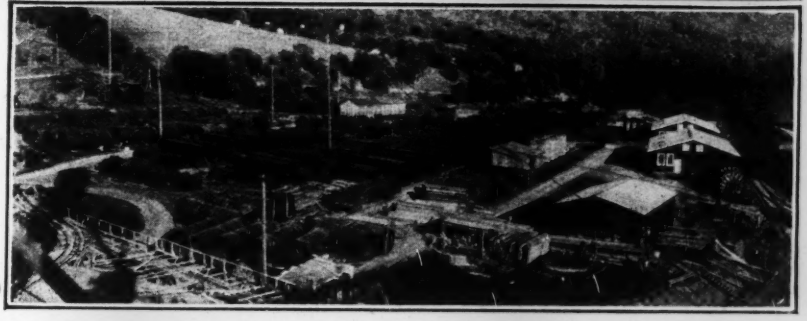
To James S. Polhemus, formerly chief assistant engineer in the First United States District, Portland, Ore., who retired from active service on March 26, was tendered a complimentary luncheon by his present and former associates at the Chamber of Commerce on June 3.

Mr. Polhemus has been identified with engineering work under the Chief of Engineers for over fifty-two years, on many important harbor works on the Northern Pacific coast, such as the jetties at the mouth of the Columbia River, the original north jetty at the entrance to Coos Bay, now being rehabilitated, together with construction of a new south jetty, the jetties at the mouth of the Coquille River and at the entrance to Yaquina Bay, the jetties at the mouth of Siuslaw and Nehalem Rivers, and the north jetty at Tillamook Bay.

Progress on Moccasin Creek Power House

The accompanying pictures show the Moccasin Creek power project, a part of the Hetch Hetchy development being carried out by San Francisco, in the stage to which construction operations had advanced early in May. This plan, which will have at the outset four 25,000-hp. impulse wheels operating under a head of 1,315 ft., is scheduled for completion this fall using water brought from O'Shaughnessy dam through the 18-mile length of tunnels in the mountain division. The last of the tunnels was holed through some months ago and the concrete lining is now being placed. Progress on the power project as a whole was reported in this journal Sept. 21, 1922, p. 492.





ABOVE—MOCCASIN CREEK POWER HOUSE UNDER CONSTRUCTION

In the background are the concrete piers for the penstock, the pipe sections for which are in the yard at the right. Halfway up the hill the main Hetch Hetchy railroad; the railroad to the power house is a spur built for the construction of this plant.

BELOW—MATERIAL YARD FROM THE POWER HOUSE ROOF

Pipe sections, reinforcing steel forms and equipment for the power house itself are stored in this yard as received. Spur tracks reach all parts of the work. The locomotive crane at the right is used in storing or loading.

Private Development Favored in Cumberland River Scheme

The Federal Power Commission has issued a preliminary permit to the Cumberland Hydro-Electric Power Co. of Frankfort, Ky., for the development of two power sites on the Cumberland River, between Burnside and Williamsburg, Ky., and of a third site on the south fork of the Cumberland River at a point near Burnside. The application for these sites was filed in conflict with an application for similar development made by the city of Louisville. The Federal Power Commission in deciding between the two applications considered that on account of the wide variation in the flow of the Cumberland River the company which developed the site would have to have a steam reserve equal to or greater than the capacity of the water power plant, which is estimated at 200,000 hp., and a large interconnected system. This the city of Louisville did not have.

The Chief of Engineers in his report on the project recommended that the applicants be required to construct locks in the dams without expense to the United States, but as these locks would cost $2,000,000 in each dam, the power company would not consider the project under such a condition. The Federal Power Commission did not consider that the power development could carry the cost of such locks and so has only made it necessary for the applicant to provide a location for locks in the dams for future use if necessary. Another consideration which militated against the construction of locks in the dam was that on account of the low flow of the river a large amount of storage is necessary and the pools behind the dams should have a drawdown of from 40 to 60 ft.

O'Shaughnessy Reservoir Filled

The O'Shaughnessy Reservoir, being constructed for the water-works of Columbus, Ohio, was filled and began overflowing on June 8. The last concrete in the overflow crest had been placed on May 26. Nine of the twelve arches for the road across the dam have been poured and it is expected that the O'Shaughnessy dam will be completed this summer. Prof. John H. Gregory, of Johns Hopkins University, Baltimore, is consulting engineer for the dam, and the engineer of construction is Clarence B. Hoover, superintendent of water-works and sewage disposal, Columbus.

Phillips Succeeds Swetland as Head of U. P. C.

Charles G. Phillips, for several years vice-president of the United Publishing Co., New York, has been elected that company's president to succeed the late H. M. Swetland, whose death was noted in these columns recently. Mr. Phillips has long been associated in the publishing of trade and industrial papers, being treasurer and vice-president, then president, of the Textile Publishing Co.

Sacramento to Survey Ship Canal for Ocean Going Vessels

Funds have been made available for the survey of a proposed deep water ship canal connecting Sacramento, Calif., with Suisun Bay, an arm of San Francisco Bay. Such a canal would allow deep water ships entering San Francisco Bay to proceed direct to Sacramento, a distance of about 94 miles, for loading and unloading, thus doing away with the present necessity for transshipment at San Francisco.

The purpose of the survey is most comprehensive in that it is planned to determine the best and most feasible route for the canal, whether it can be built at a reasonable cost, and whether the benefits to be derived by the entire Sacramento Valley from its construction and the ensuing traffic through it, would be sufficient to justify the expense.

The sum appropriated amounts to $11,000, of which $5,000 was subscribed by the city council of Sacramento, $1,000 by the Sacramento Chamber of Commerce, and $5,000 by the county supervisors. City manager H. C. Bottorff and the river and harbor improvement committee have been authorized to work out a plan for the survey and to arrange for the employment of an engineer to carry out the work.

Changes in State R.R. Law Do Not Affect Old Agreements

An opinion of considerable importance in the matter of maintaining highway bridges over railroads or subways under railroads in New York State has been rendered by the attorney general. It applies to a section of the state railroad law which, as revised in 1924, places the responsibility for the maintenance of the roadway and approaches for such crossings upon the state highway department only when the crossing has been constructed as part of a state or county highway. Previously, the state highway commission had been responsible for the maintenance of the roadway and approaches of such railroad crossings even where the approaches only have been constructed as part of a state or county highway.

The specific case in question was one in which in 1923, previous to the amendment of the state railroad law, the bureau of highways had agreed with the Pennsylvania R.R. Co. to reconstruct the concrete flooring upon an overhead bridge on a state highway in the town of Holland, the railroad company agreeing to reconstruct the remainder of the structure by replacing the old steelwork and the old abutments.

The amendment was passed between the time that the railroad company delivered the steelwork for the new structure at the site and the time that the highway bureau was ready to start work on the roadway, and the bureau of public works requested an opinion as to whether or not such an amendment had the effect of abrogating such an agreement made prior to its enactment.

Random Lines

The Engineer in Politics

After the preliminary jockeying in the first two ballots for the vice-presidential nominee, the Republicans at Cleveland settled down to two men, Hoover and Dawes. The first, of course, is well known as an engineer but few know that General Dawes earned his way through college by working as engineer for a small railroad and that he went to France as Lieutenant Colonel of the Seventeenth Engineers. His major activity has been in the professions of banking and the law, but the remnants of his engineering training show through sometimes in his capabilities—and his force of expression. No mere lawyer or banker could possibly achieve such distinction in expletive and epithet.

* * *

"Lives of Great Men All Remind Us"—

Sir: I have read with interest your column headed "Random Lines," and am enclosing a clipping taken from the Los Angeles *Evening Express* of June 7, which no doubt will afford the readers of the *Engineering News-Record* a small amount of pleasure.

Q. Don't you think that instead of sending some of those soap-box orators and loafers to jail it would be a good idea to send them to school and have them learn a trade? They yap about there being no chance for the working man. Well, four years ago I was a laborer; now, through going to night school and studying in my spare time, I hang out to be a welding engineer. Anybody with ordinary brains could do better than I if they like to work.

* * *

Science vs. Politics

Science continues to add to its triumphs. After listening over the radio to the speeches at the national conventions we have concluded that it is a fair bet that this latest scientific marvel will accomplish the impossible—it will debunk the political speech. In the old days only a few thousand—and most of them professional politicians—had to listen to convention speeches. The ordinary citizen noted that they covered pages of his daily newspaper and read them only by centerheads and headlines. Last month millions of people sat in the quiet of their own apartments, insulated from the mass hypnotism of the convention crowd, and for the first time listened to the incredible nonsense of a convention speech. Surely, the reaction will be felt by the politicians. One keynote speech we heard must have lost half-a-million votes for the party it was intended to laud, unless the average intelligence of the American voter is even lower than the 13-year old level the army psychologists proclaimed. All that is necessary to clean up politics completely is to install a broadcasting station in the houses of Congress.

Civil Service Examination

UNITED STATES

For the following civil service examination apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission.

Consulting Highway Engineer—Vacancy in the U. S. Bureau of Public Roads, Department of Agriculture, for service in highway research or on projects; salary $4,000 to $5,000; fifteen years' experience is required. Applicant will not be required to report for examination but will be rated on education, experience and publications or officials reports to be filed with application. Receipt of applications will close **July 22.**

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Rochester, N. Y.; Sept. 30 to Oct. 3.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburgh, Fla.; Annual Convention, Boston, Mass., Sept. 29-Oct. 3, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Detroit, Oct. 23-25, 1924.

The **Washington Irrigation Institute** will be held in Yakima, Wash., Nov. 20-21, 1924. Joseph Jacobs, Seattle, president, R. K. Tiffany of Spokane, R. B. Williamson and G. C. Finley of Yakima, are in charge of the program. An invitation to attend has been extended to Dr. Elwood Mead, director of the U. S. Bureau of Reclamation, and Addison T. Smith, congressman from Idaho.

The Duluth, Minn., Section of the American Society of Civil Engineers at its recent annual meeting elected O. H. Dickerson, assistant engineer of the Duluth & Iron Range R.R., president; E. H. Dresser and H. C. Ash vice-presidents, W. C. Brockway secretary; and John Carson treasurer.

The Pittsburgh (Pa.) Chapter of the American Association of Engineers at its annual dinner recently had as guests W. L. Benham, president of the association, Dr. F. H. Newell, and C. J. Ullrich, field secretary of the association. Mr. Benham's speech was on "The Greatest Need of the Association." The dinner was preceded by an inspection trip to the Mellon National Bank, U. S. Engineers and city and county offices, and to the city filtration plant at Aspinwall.

The New England Water Works Association has nominated the following officers for the coming year: president, Stephen H. Taylor, superintendent of water-works, New Bedford, Mass.; vice-president, Frank E. Winsor, chief engineer, Water Supply Board, Providence, R. I.; and treasurer, Albert L. Sawyer, water registrar, Haverhill, Mass.

The Niagara District Branch of The Engineering Institute of Canada has elected the following officers: E. P. Johnson, president; H. L. Bucke, St. Catharines; vice-chairman; and R. W. Downie, Thorold, secretary-treasurer.

Personal Notes

D. S. MACBRIDE was the guest of honor at a testimonial dinner given in Philadelphia, last month, by highway and structural engineers on the occasion of his resignation as Philadelphia district engineer for the Portland Cement Association. Mr. MacBride is now associated with the International Cement Corporation, New York. L. N. Whitcraft, who has been in charge of the Portland Cement Association's work in New Jersey, has been appointed head of the Philadelphia office to fill the vacancy caused by Mr. MacBride's resignation.

GORDON GRANT, formerly chief engineer of the highways branch, Department of Railways and Canals, Ottawa, Canada, has been appointed principal assistant engineer, Central Region, Canadian National Rys., in succession to H. T. Hazen, who has been transferred to Montreal.

J. R. HUNT has been appointed highway engineer of Mingo County, West Virginia, with headquarters at Williamson, succeeding Holton Cook who recently resigned.

WILLIAM S. FREEL, Newcastle, Ind., surveyor of Henry County, has been appointed city engineer of Greenfield, Ind., to succeed Myron Morehead, and will have charge of plans for paving and sewer construction projects.

MAJOR FRANCIS K. NEWCOMER, Corps of Engineers, U. S. A., assumed on June 30 the duties of U. S. district engineer of the Charleston, S. C., district, where he succeeds Colonel Edgar Jadwin who recently became assistant chief of engineers at Washington. In the interim, Major Dan I. Sultan, of the Savannah, Ga., district is acting district engineer at Charleston.

COLONEL HARRY BURGESS, Corps of Engineers, stationed at Fort Sam Houston, Texas, has been assigned to duty as commandant of the engineering station and school at Fort Humphreys, Virginia, to take effect September 1. He will relieve Colonel James A. Woodruff, Corps of Engineers, scheduled for other duty.

C. G. LOCKE was recently appointed city engineer of Salamanca, N. Y., to succeed M. H. Regan, resigned.

CHESTER A. SMITH, for fifteen years associated with the Burns & McDonnell Engineering Co., consulting engineers of Kansas City, Mo., and Los Angeles, Calif., has been made a member of the firm, with full charge of its office in Los Angeles, the firm in that city being designated as the Burns-McDonnell-Smith Engineering Co., the home office in Kansas City retaining the same name as formerly. R. L. BALDWIN and C. F. LAMBERT, of the Kansas City office, have become members of the firm there.

ROGER L. MORRISON, until recently engineer of tests at the Pittsburg Testing Laboratory, has been appointed associate professor of highway engineering and director of the Michigan state highway laboratory at the University of Michigan; his previous service was as treasurer and general manager of the Concrete Products Company of Birmingham, Ala., and professor of highway engineering at the A. and M. College of Texas.

Obituary

HAROLD DYER, a member of the firm of Higgins-Wall-Dyer Contracting Co., St. Louis, Mo., was drowned June 24 when he accidentally fell into the River Des Peres at Lindenwood, a St. Louis suburb. Due to heavy rains the river was out of its banks and Mr. Dyer was inspecting work on the first section of the project between Leamington and Piccadily Avenues, for which his firm has the contract. He was 35 years old.

LOUIS STERNE, well-known engineer of London, England, but born in Philadelphia, Pa., and always an American citizen, died May 30 at his home in Whitehall Court, London, aged 89 years. Mr. Sterne spent some years of his youth in the Baldwin locomotive works in Philadelphia and one of his early achievements was taking a locomotive from there to its destination in Ohio. Later in work in the repair shops of the Louisville & Kentucky Ry. and railroad work in the West he developed mechanical appliances which were the beginning of a long series of patents. In 1857 he returned to his father's business in Philadelphia, and at this time became a personal friend of Abraham Lincoln, who during the Civil War sent him to European countries for the purpose of preventing the equipment of blockade runners for the Southern states. In 1865 he became a resident of London. The firm of Thompson, Sterne & Co. (later changed to L. Sterne & Co., Ltd.) was formed for the construction of refrigerating machinery, in which Mr. Sterne introduced improvements in cold storage equipment and refrigerating plant. He was associated with the laying of the first Atlantic cable and in the construction, under the late Mr. Greathead, of London's first tube railway by means of the Greathead shield.

GEORGE RAYNER, head of the civil engineering firm of George Rayner & Sons, Yonkers, N. Y., died June 26 at his home in that city, at the age of 86 years. He was born in England and graduated from Thwaite's University there, but had been a resident of Yonkers since 1868.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Test Liquid Oxygen in Large Quarry Blast

New Explosive Lifts 4,500 Tons of Rock —Results Compared with Those from Dynamite

ECONOMIES in blasting with liquid oxygen are indicated by the results of a large-scale commercial test made April 11 at the quarry of the Calcide Quarry Co., Myerstown, Pa., under the joint direction of the Ingersoll-Rand Co., New York, which has adopted the system of Dr. Georges Claude, the French physicist, for the manufacture of liquid oxygen in large quantities, and the Air Reduction Co. From a report of the demonstration by F. W. O'Neil, chief engineer of the Ingersoll-Rand Co., the following notes have been taken:

Drill Holes—For the blast there were drilled twelve holes, each 28 ft. deep and 5¼ in. in diameter, spaced 12 ft. apart on a bench 30 ft. wide. The cartridges were 5 in. in diameter and 18 in. long, five of them being placed in each hole. Stemming consisted of loose loam poured into the holes but not tamped.

Cartridges—The liquid oxygen was delivered in forty 15-liter containers shown in the accompanying photograph. When shipped on April 7 they contained a net weight of oxygen of 1,541 lb., which was lowered by evaporation to 1,014 lb. on April 11—a loss of 527 lb., or 34 per cent, during a period of 88 hr. Cartridges consisting of muslin bags filled with absorbent carbonaceous material were soaked for about 30 min. in the oxygen, a total of 61 cartridges requiring 921 lb. of oxygen for saturation. (One cartridge was not used). The theoretical weight of oxygen needed for the 61 cartridges is 525 lb.; the excess of 75 per cent is provided for evaporation prior to the blast.

The twelve holes of the blast were shot in unison. There was an interval of 1 hr. 35 min. from the moment the first of the cartridges was taken out of the liquid oxygen bath until the blast was set off. This point, Mr. O'Neil states, is an important one for it emphasizes that large quantities of liquid oxygen can be used for a single blast and ample time allowed for the deliberate placing of the cartridge. The firing was done by TNT Cordeau. According to officials of the quarry company, a similar blast under ordinary conditions would require 85 lb. of 40 per cent dynamite in each hole, or a total of 1,020 lb. of dynamite.

Results and Costs—It was estimated that the liquid oxygen blast broke down 4,500 tons of rock, or 6.2 tons per pound of liquid oxygen employed. Using dynamite, the breakage would have been 4.4 tons of rock per pound of explosive.

Estimates of cost placed the total outlay for liquid oxygen explosive at $57.68 as against $135.15 for an amount of dynamite to do the same work. The expenditure for liquid oxygen was 1.28c. per ton of rock broken as against 3c per ton for dynamite. On this basis, the cost of the liquid oxygen was 42⅝ per cent of that of dynamite. On the assumption that the blast was overshot to the extent of 20 per cent, then the outlay for liquid oxygen, according to Mr. O'Neil, can be placed at 34 per cent of that of dynamite.

Liquid Oxygen Containers (on Floor) and Cartridges (in Wood Crate)

The Myerstown blast is the first of its kind on a commercial scale ever made in a United States quarry and is believed to be the largest blast of liquid oxygen explosive thus far made.

To Reduce Manhole Varieties

Plans for reducing the sizes and types of manholes are under consideration by the Division of Simplified Practice, Department of Commerce, which recommends a conference to develop uniform specifications calling for a better average grade of material. With the co-operation of foundrymen and city engineers, such simplification would enable the foundries to bid on work for several communities at a time, and to spread pattern costs over a larger volume of orders.

Master Specification Issued for Roofing Asphalt

The Bureau of Standards, Washington, D. C., has just published specification No. 84, of the Federal Specifications Board, for asphalt for mineral-surfaced roofing. The specification applies to asphalt intended for use with asphalt-saturated rag felt for roofing and waterproofing in the construction of mineral-surfaced built-up roofing on inclines not exceeding 3 in. to the foot. Either petroleum asphalt or mixtures of refined Trinidad asphalt with petroleum asphalt or asphalt fluxing materials will be acceptable under these specifications, but the contract must state the kind to be furnished.

Steel Tariff Adopted by India

Washington Correspondence

The steel industry protection bill, designed to give complete effect to the Tariff Board's recommendations for protection to the manufacture of steel in India, has been adopted by the Indian Legislative Assembly, with certain modifications, and became effective June 13. The recommendations to the Tariff Board were limited to three years and were designed to secure to the Indian manufacturer of steel an average selling price of 180 rupees per ton. It was proposed to increase the import duty on unfabricated structural steel shapes, ship, tank and bridge plates, certain kinds of bars and rods, and black sheets. In addition it was recommended that further protection in the form of a bounty be given rails and fishplates and that increased import duties be imposed on uncoated wrought-iron bar and rod, wrought-iron shapes, tinplate, wire and wire nails.

Business Notes

OSGOOD CO., Marion, Ohio, manufacturer of revolving and railroad type steam shovels, railroad ditchers, locomotive cranes and dipper dredges, announces the transfer of N. E. Otterson, of the New York district sales office to the Chicago district sales office and of his promotion to district sales manager in charge of the Chicago District. He succeeds C. A. Phillips, formerly in charge of the Chicago District, who has resigned to go into business for himself.

RIDENOUR, SEAVER & KENDIG, representatives in Cleveland and Pittsburgh of the Industrial Works, Bay City, Mich., have opened a branch office at 773 Ellicott Square Building, Buffalo, N. Y., to take care of the western New York territory.

KEYSTONE MACHINE & ENGINEERING CO., manufacturer of filter equipment, has moved its general offices and works from Oil City to Sharon, Pa.

C. D. PRICE, who for many years has been connected with the Industrial Works at Bay City, Mich., recently as traveling service engineer, has been appointed district sales manager of the St. Louis district with headquarters in the Railway Exchange Building, St. Louis.

H. N. SPICER, of the executive staff of the Dorr Co., New York, sailed June 4 for London, as the first step of a tour of Europe that will take from four to six months and will cover practically every important industrial section of the Continent. He will make a special business survey, both in a general way, and in connection with the Dorr Co.'s European business. His headquarters will be in London, at 16 South St. E. C., but he will spend most of his time in Spain, Italy, Austria, Czecho-Slovakia, Poland and Germany.

GUNITE CONCRETE & CONSTRUCTION CO., Kansas City, Mo., has been incorporated with a capital of $60,000, fully paid up. The new organization, headed

by Barclay A. Greene, president, is, in effect, the former cement gun department of the Pratt-Thompson Construction Co., general contractors, Kansas City, with which the new corporation is affiliated. The formation of the new company, it is announced, is the result of rapidly increasing business involving the use of gunite for waterproofing, repair work and general construction. Mr. Greene was formerly manager of the cement-gun department of the Pratt-Thompson company.

WILLAMETTE EQUIPMENT CO., Portland, Ore., has been appointed distributor for Monarch Tractors, Inc., Watertown, Wis., in Oregon, western Washington and northern California.

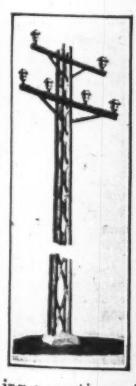
ARTHUR T. UPSON, chief of the section of industrial investigations of the U. S. Forest Products Laboratory, Madison, Wis., tendered his resignation, effective June 30, to join the staff of the National Lumber Manufacturers Association. His duties with the latter will be to assist the various regional associations, and to co-operate with the lumber trade and lumber consumers in introducing and developing the new national lumber standards which went into effect on July 1.

UNION PAVING CO., Philadelphia, is building a new asphalt mixing plant along the Schuylkill River. The materials used, with the exception of trap rock, will be shipped in by water. The foundation work has been let to Latta & Roberts. J. F. Nourse is in charge of the general layout and structural design, and construction of the plant is under the direction of H. B. Lloyd. The completed plant will cost approximately $150,000.

Equipment and Materials

New Pressed Steel Pole

The Truscon Steel Co., Youngstown, Ohio, announces that its new steel-pole department has begun quantity production of all sizes of steel poles up to 50 ft. in length. The poles, pressed from 5- to 12-in. steel channels or I-beams, are so designed that no special equipment is needed by the lineman in ascending or descending, thus eliminating pole steps and the necessity for use of spurred climbers.



Adaptable for use on transmission and distribution lines, telephone, trolley and street lighting systems, and, in fact, for every pole purpose, the new pole is made by pressing a portion of the web of the channel or I-beam out to a predetermined angle, then riveting this pressed out section to a like section of another channel or I-beam.

A complete line of galvanized fittings has been designed for the steel pole to fit any size standard cross-arm, either wood or steel.

Mobile Crane Designed for Motor Truck Mounting

For mounting on a motor truck chassis the Orton & Steinbrenner Co., Chicago, has placed on the market a full-circle crane designed to handle a ½ or ¾-yd. bucket. The crane can be mounted on any new or second-hand truck of 5 tons capacity having a distance back of the driver's seat of 8 ft. to the center of the rear axle. A feature is a removable counterweight compartment. As the laws of some states do not permit loads in excess of 10 tons to travel over hard surfaced roads the ballast which is necessary to maintain the balance may be dropped out by simply opening the bottom of the compartment. Sand is generally used for ballast.

All wearing surfaces and bearings

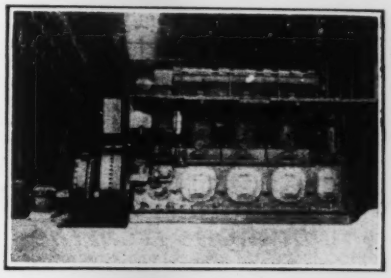
are bushed with removable bronze bushings. The frictions for operating the hoisting drums and swinging are bronze cone with outside band brakes. The main train of spur gears are cut steel. Lubrication is provided for by the Alemite pressure system.

Power is furnished by a four-cylinder, 37-hp. Hercules gasoline motor. Double drums are furnished on the main drum shaft, and power is supplied to both so a bucket may be hoisted while open as well as closed.

In addition to the handling of sand, stone or gravel with a bucket the crane is suitable for such other purposes as loading and unloading cars or trucks, driving piling, handling structural steel, lumber and sewer pipe, and excavating for building foundations. With a generating set the crane can operate a 36 in. electromagnet and handle scrap iron, pig iron, or castings around a foundry.

Diesel Engine Makes Non-Stop Run of 202 Days

A continuous run of 202 days, under actual working conditions, is reported by the Worthington Pump & Machinery Corporation for a Worthington-Snow Diesel engine used by the city of Horton, Kan., for lighting and power purposes. The engine is a standard 562-hp., four-cycle, air injection type machine operating at 225 r.p.m. It drives an alternating current generator in parallel with another unit-evidence,



the manufacturer points out, of close governing as well as continuity of performance through the entire period. The engine has three cylinders, each 22⅛ x 22⅛ in. and of the so-called square type; the pistons are oil-cooled; lubrication is forcibly fed to all parts of the engine.

In small municipal plants loads vary considerably, from heavy to light. The Snow engine, it is reported, met all conditions without difficulty and satisfactorily fulfilled the guarantee made by the manufacturer.

New Chip Spreader for Road Work

A stone, chip and sand spreader for road construction and maintenance, in the form of a dump body on four wheels, which may be either pushed or pulled by a motor truck, has been developed by the Universal Road Machinery Co., Kingston, N. Y. The capacity of the body is 3-tons of material struck off level, which, the manufacturer claims, will cover from 500 to 1,000 ft. of roadway, the spreading width being 8 ft.

The tail-gate of the body is fitted with a mechanism controlled by the operator which varies the slot opening and regulates the amount of material deposited. The method of operation is indicated in the accompanying photograph. With this spreader the material is deposited in front of the wheels, an advantage in cases involving the placing of a stone chip surface layer on a

newly oiled road. The unit has been designed for operation by a Fordson tractor or a truck. When it is pulled, instead of pushed, an offset hitch may be provided. The spreader is fitted with solid rubber tires and springs and the wheels are equipped with roller bearings.

Test Fire-Proofing Paint

The Bureau of Standards, Washington, D. C., is making tests of Burnot fire-proofing paint; the same paint is also being tested by the Building Department of the City of Denver. The manufacturers of this paint make claims for it, which, if supported by

tests and experience, will overcome a large part of the opposition to the use of lumber in places exposed to the initial sources of ignition such as burning papers, cigarette butts, electric short circuits, and other minor fire beginnings which are the cause of 90 per cent of all fires in buildings.

Publications from the Construction Industry

Air Lift Pumping—SULLIVAN MACHINERY CO., Chicago, in a 48-p. illustrated bulletin describes applications of its air-lift pumping systems. The text covers both methods and apparatus. There are notes on the construction of wells in sand and gravel formations followed by illustrated descriptions, with operating data, on typical installations, with suggestions regarding best practice. Details are given, with cross-sectional drawings, of the company's foot-pieces, well tops, mixing tubes and auxiliary starting jets. From the company's experience in this field there is presented a tabulation showing the ratio of lift to submergence for various jets. Air-lift pumping systems are built in sizes ranging from 1½ to 15-in. discharge. The bulletin concludes with a number of tables containing data on pipe sizes, weights and couplings, and friction loss of head.

Fireproof Roofs — FEDERAL CEMENT TILE CO., Chicago, has published a folder on the rising cost of insurance on buildings, with figures proving that forethought in constructing a more fireproof building, particularly fireproof roofs, will lower the insurance rates by substantial amounts in some cases, and increase the margin of safety in any case.

Alloy Steels — TAYLOR-WHARTON IRON & STEEL CO., Highbridge, N. J., points out in a 22-p. illustrated booklet the advantages of using long-wearing alloy steel for parts of construction and industrial equipment subjected to heavy use. A number of applications of manganese steel are suggested, including chain links for conveyors, sheaves, gears, sprockets, rock crusher jaws, dipper teeth, dredging machinery, track frogs and crossings, crane wheels, dredge buckets, screens, etc. Instances are given where the substitution of alloy for less durable steels has resulted in substantial savings.

Air Filters for Compressors—MIDWEST AIR FILTERS, INC., New York, has issued a 24-p. illustrated pamphlet on the application of its air filters to compressors and internal combustion engines. The object of the filters is to exclude from the engine or compressor dust or other abrasive materials which decrease the efficiency and increase the wear of the machine. The filters consist of steel boxes with expanded metal fronts and are filled with small cylindrical filter bodies coated with a viscous fluid. Charts are given to aid in selecting the proper size of filter for various compressors.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Business Briefs

Call money, June 23, loaned at 2 per cent.

Prime money rates ranged from 2¾ to 3½ per cent.

Commercial paper rates were 3½@4¼ per cent.

Foreign exchange (Demand).

	Normal	This Week	Last Week	Year Ago
Sterling	$4.8665	$4.33¼	$4.32 7/32	$4.61¼
Franc	0.193	0.0542½	0.0534½	0.0685
Lira	0.193	0.0433¼	0.0432½	0.0452½

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in construction News, pp. 1 to 11, are the following:

Bank and Office, Dallas, Tex., for Republic Building Co., $1,500,000.

Hotel, New Orleans, La., for Union Indemnity Co., $1,250,000 to $1,500,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 1 to 11, are the following:

Training School, New York, N. Y., to E. Diebitsch, $1,735,000.

Hotel Durham, N. C., to Blackford Co., $1,000,000.

Railway shops, Hayne, S. C., to Dwight P. Robinson Co., $3,000,000.

Foreign Projects of Interest to Americans

A number of foreign construction projects which should be of interest to American engineers, contractors and manufacturers have been reported by the United States Department of Commerce. They are noted here, further information being available at the Bureau of Foreign and Domestic Commerce or its district co-operative offices when a reference number is given.

Filtering installation in Egypt. Tenders have been invited for installation of water conduits and filters at Assuan. Plans and descriptive matter may be examined by accredited American concerns at 734 Customhouse, New York City.

Railway being promoted by Indian planters. The construction of a railway approximately 80 miles long extending through the South Indian hill tracts is being promoted by the planters of this section. Reference No. 134,523.

Repaving in city of Paris. The work to be done involves 911,000 square meters of paving, part of which is to be wood block and part asphalt resurfacing. The contract for paving is to include a provision for maintenance over a period of 15 years. (Commercial Attaché Chester Lloyd Jones, Paris, France).

Hydro-electric plant for Jequie, Brazil. A mercantile firm has acquired control of a waterfall near the town and expects to build a plant to furnish light and power to the city. Reference No. 132,700.

Cement Output Increasing—Steel Slowing Down

The present upward trend in cement production, although seasonal, is in direct contrast with the recent curtailment in the steel ingot output.

The relation that these two basic materials bear to each other, in reinforced concrete construction, is very close. It is evident then, that the June total of cement production will show a decrease, compared with that of the month preceding, or that the steel industry will enlarge its production schedules to a degree commensurate with the present cement output. The former is the more probable for the reason that the June, 1923, cement output was slightly below that of the month preceding.

Steel ingot production for the entire country during 1923, according to the American Iron and Steel Institute, was but slightly under the record total of 1917, the first war year.

The first five months of this year, however, show a decided falling off, compared with the corresponding period in 1923. The following table shows the steel ingot production situation during the past sixteen years.

Year	Tons
1909	23,298,729
1910	25,154,087
1911	23,029,479
1912	30,284,682
1913	30,280,110
1914	22,819,784
1915	31,284,212
1916	41,401,917
1917	43,619,200
1918	43,051,022
1919	33,694,795
1920	40,881,392
1921	19,224,084
1922	34,568,418
1923	43,485,665
1923 (first 5 mos.)	19,559,709
1924 (first 5 mos.)	17,592,562

Cement, however, attained its record production mark in 1923, with a total output of 137,460,238 bbl. for the entire country, according to the Geological Survey. The following shows the cement situation with relation to production, shipments and available supplies:

1923	Production Barrels	Shipments Barrels	Stocks on Hand at End of Month Barrels
Jan.	7,990,000	5,628,000	11,477,000
Feb.	8,210,000	6,090,000	13,596,000
Mar.	9,880,000	10,326,000	13,045,000
Apr.	11,359,000	12,954,000	11,463,000
May	12,910,000	14,257,000	10,144,000
5 mos.	50,349,000	49,255,000	.....
1924			
Jan.	8,788,000	5,210,000	14,155,000
Feb.	8,588,000	5,933,000	16,815,000
Mar.	10,370,000	8,995,000	18,189,000
Apr.	11,726,000	12,771,000	17,159,000
May	13,777,000	14,551,000	16,385,000
5 mos.	53,249,000	47,460,000	.....

Entire Year	Production Barrels	Shipments Barrels	Stocks on Hand at End of Year Barrels
1922	114,789,984	117,701,216	9,352,250
1923	137,460,238	135,912,118	10,900,370

Volume of June Construction Below Preceding Month and Corresponding Period in 1923

New England Only Section of Country To Show An Increase—Sewers, Excavations and Federal Government Work Gain

Contracts awarded on large engineering construction projects, as published in the four issues of *Engineering News-Record* during June, reached $155,140,000 as against $257,665,000 in the five issues of May, 1924. Awards published in the four issues of June, 1923 amounted to $188,786,000.

The average weekly value of June lettings was $38,785,000 as compared with $51,533,000 for May.

Minimum costs observed in the Construction News section of *Engineering News-Record* on each class of construction are as follows: Water-works and excavations, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

The money value of contracts awarded during June was smaller than that for the month preceding in all sections of the United States except New England, which showed a gain of about a million dollars. The Middle Atlantic states fell off nearly $27,000,000 despite the fact that large awards in New York City alone amounted to $12,603,871 at the minimum costs just mentioned. New York awards during May of the current year totaled $16,204,916.

Despite the general falling off in construction there were gains during June in lettings for sewers, excavations, drainage and irrigation projects and Federal Government work.

Although the physical volume of June construction was under that of the corresponding month in 1922 and 1923, it was also heavier than for the same period in the three preceding years.

Among the large projects awarded during June were the following: An apartment, Buffalo, N. Y., $2,000,000; an orphanage, Cleveland, O., $2,000,000; a medical and dental office building, Seattle, Wash., $2,500,000; a sewer, Los Angeles, Calif., $2,706,000; a market, New York, N. Y., $2,841,986; a bridge over the Delaware River, Philadelphia, Pa., $2,977,450 and a power development, Copco, Calif., $4,000,000.

Engineering News-Record Construction Cost Index Number

July, 1924	214.40
June, 1924	216.85
July, 1923	222.10
Peak, June, 1920	273.80
1913	100.00

Jan., 1923	191.70	Sept.	221.50
Feb.	197.40	Oct.	220.30
Mar.	205.25	Nov.	220.90
Apr.	213.50	Dec.	217.30
May	216.70	Jan., 1924	217.90
June	220.70	Feb.	220.30
July	222.10	Mar.	224.70
Aug.	221.50	Apr.	221.60
		May	222.38

Engineering News-Record's Construction Cost Index Number declined 2.45 points since last month, owing to lower steel and lumber prices. The average rate for common labor is still 56c. per hr., against 55c. three months ago and 54c. in July, 1923. Thus general construction cost is 3 per cent lower than one year ago and 22 per cent under the peak; it is 114 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly

June, 1924 *(4 issues of E. N.-R.)*	126
May, 1924 *(5 issues of E. N.-R.)*	206
June, 1923 *(4 issues of E. N.-R.)*	148

Yearly

1923 (entire year)	135
1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1919 (entire year)	91
1918 (entire year)	80
1917 (entire year)	64
1913 (entire year)	100

Engineering News-Record's Construction Volume Index Number is 126 for the month of June, and 135 for the whole of 1923, as against 100 for 1913. This means that the actual volume of construction in 1923 (not the mere money-value of the contracts let that year) is 35 per cent above the volume of construction for 1913. Our monthly volume number, 126 for June, 1924, contains the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN UNITED STATES AND CANADA, JUNE, 1924

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Western	United States	Canada	Grand Total
Waterworks	$580,000	$657,000	$211,000	$659,000	$1,653,000	$75,000	$3,835,000	$777,000	$4,612,000
Sewers	205,000	2,132,000	518,000	2,578,000	1,093,000	3,291,000	9,822,000	989,000	10,811,000
Bridges	133,000	3,002,000	581,000	746,000	1,105,000	366,000	5,933,000	.....	5,933,000
Excavation, drainage, etc.	20,000	348,000	312,000	93,000	790,000	1,500,000	3,063,000	.....	3,063,000
Streets and roads	1,720,000	10,526,000	4,764,000	10,437,000	9,892,000	4,413,000	41,752,000	2,742,000	44,494,000
Industrial works	1,120,000	2,790,000	910,000	1,535,000	2,216,000	392,000	8,963,000	505,000	9,468,000
Commercial Buildings	6,252,000	23,145,000	4,893,000	11,303,000	6,227,000	7,131,000	58,951,000	1,102,000	60,053,000
Federal government	12,000	1,022,000	170,000	1,702,000	104,000	1,085,000	4,095,000	.....	4,095,000
Unclassified	53,000	1,361,000	420,000	2,894,000	1,120,000	4,739,000	10,587,000	2,024,000	12,611,000
Total June, 1924	$10,095,000	$44,983,000	$12,779,000	$31,947,000	$24,205,000	$22,992,000	$147,001,000	$8,139,000	$155,140,000
Total May, 1924	9,358,000	71,505,000	27,650,000	54,498,000	48,761,000	31,962,000	243,734,000	13,931,000	257,665,000
Total April, 1924	5,769,000	46,203,000	20,614,000	40,501,000	24,504,000	25,978,000	163,569,000	11,346,000	174,915,000
Total three months	25,222,000	162,691,000	61,043,000	126,946,000	97,470,000	80,932,000	554,304,000	33,416,000	587,720,000

Labor Rates and Conditions Throughout the Country

There has been a steady decline in mill and factory employment throughout the entire country during the past month. A few exceptions to the general trend, however, are noted in lumber and cement mills, brickyards and factories producing hardware and electrical equipment. These, of course, have to do with construction, which has been holding its own during the recent depression in other industries.

Despite the widespread dismissal of factory employees and adoption of part-time schedules, there are two favorable factors to be taken into consideration at the present time. They are: (1) The absorption of unemployed factory labor by agriculture, construction and other seasonal occupations; (2) a slight drop in the cost of living during May. The National-Industrial Conference Board's index of living costs shows a slight decline in clothing and a more substantial decrease in fuel prices during the month ended May 15, 1924.

The average rate paid common laborers (pick and shovel men) in construction operations is still 56c. per hr. for the entire country. The same rate prevailed during May and June. In April, however, it was 55c. and remained at 54c. per hour from July, 1923, to March, 1924. Local conditions as reported to *Engineering News-Record* follow:

Atlanta — Construction continues

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by —)

Cities	Brick-layers	Car-penters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	1.75	.90@1.20	1.00@1.12½	1.00	$0.65	1.12½	.40
Birmingham	1.00	.35@.75	.75@1.00	.30@.45	.....	1.00	.25@.40
Boston	1.25	1.00@1.10	1.25@1.35	.82½	1.05	1.12½	.60@.75
Cincinnati	1.50	1.20	1.20	.92½	1.20	1.20	.55
Chicago	1.25	1.15	1.00@1.25	.88¾	1.10	1.25	.82½
Cleveland	1.50	1.25	1.25	.87½	1.00	1.37½	.87½
Dallas	1.50	1.00	1.00	.40@.75	.87½	1.00	.30@.50
Denver	1.62½	1.12½	1.12½@1.18¾	.81¼@.87½	1.00	1.15⅝	.35@.55
Detroit	1.50	.90@1.00	.85@1.00	.90	.85@1.00	1.12½	.60@.75
Kansas City	1.37½	1.12½	1.00@1.25	.90	1.00	1.15	.40@.70
Los Angeles	1.25	1.00	1.00	.62½	.....	1.00	.50
Minneapolis	1.12½	.87½	.87½	.71½	.....	.87½	.50@.55
Montreal	1.00	.65	.62½	.45	.50	.65	.25@.30
New Orleans	1.25	.90	1.00	.65	.80	1.00	.35@.40
New York	1.50	1.31¼	1.50	1.00	1.00	1.31¼	.62½@.75
Philadelphia	1.50	1.12½	1.02¼	.70@1.00	1.00	1.12½	.40@.45
Pittsburgh	+1.55	1.37½	1.12½	1.00	.....	+1.37½	.70
St. Louis	1.75	1.50@1.60	1.50@1.67½	1.15@1.25	1.25	1.50	.45@1.10
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.25	1.00	1.00@1.12½	.93¾	1.00@1.12½	1.12½	.62½

active, judging by heavy demand for building materials.

Baltimore — Conditions normal in skilled building trades; unemployment still reported in other industries.

Birmingham — Surplus of common, unskilled laborers. Building active but plenty of skilled mechanics for all jobs. Carpenters especially plentiful.

Boston—Labor plentiful; new building projects scarce. City department heads ordered to refuse all awards to contractors who neglect to pay at least 65c. per hour to laborers on city work.

Dallas—Skilled trades all employed; little unemployment among common laborers.

Detroit—Employers have agreed to new plasterers' wage rate of $12.50 per day. Help more plentiful owing to recent curtailment in automobile and other industries.

Minneapolis—Labor plentiful; building operations light.

Montreal—No scarcity in any of the building trades.

New York—Structural steel workers on strike since May 1. Demand $12 per day against present rate of $10.50 and also adoption of closed shop. Condition beginning to affect other trades. Ornamental stone workers demand $14 per day, against former rate of $12 and also abolition of air hammers on soft-stone work.

Philadelphia—Falling off in demand for common labor. Supply excessive because of curtailment in soft-coal production.

Pittsburgh—According to new 1924 wage schedule, bricklayers and structural ironworkers get advances of 15c. and 12½c. per hour respectively. A scarcity of hod carriers is reported.

San Francisco—Building trades actively employed; dullness reported in other industries.

Cleveland—Inside electricians get increase of 12½c. per hour; making present rate $1.37½ per hour.

St. Louis—City flooded with skilled building trades mechanics. Base pay $12 per day. Unskilled laborers rate, 45c. to 75c. per hour for non-union men.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Price Trend Continues Downward Course—Demand and Production Slower Than Month Ago

Pig Iron—Curtailment in pig-iron production continues. No. 2 foundry iron, $20@$21 per ton, Birmingham; unchanged during week. Demand extremely slow. Current iron quotations are about $6 per ton below a year ago.

Railway Supplies—Declines in freight loadings and the large number of surplus cars and locomotives have combined to lessen demand for railway equipment during the past month. Oak and cypress ties are cheaper.

Pipe—Mill stocks are limited; demand slow. Discounts on basing card of April, 1923, still in effect. No change in warehouse prices of wrought-steel pipe. Cast-iron and sewer pipe, however, have registered several declines since June 5.

Road and Paving Materials—Slight downward trend in prices of paving stone, wood blocks, road oils and asphalt.

Sand, Gravel and Crushed Stone—Of twenty-one cities reporting regularly to *Engineering News-Record*, only one, St. Louis, reports local adjustments of gravel prices. Sand declined in but two cities, Boston and St. Louis.

Lime—The price trend in this material is upward, particularly in San Francisco, St. Louis and Birmingham. There is no surplus of reserve stocks.

Cement—Slight declines reported in Boston and Montreal since issue of June 5. Prices same as month ago in forty-four other cities reporting.

Steel—Slight improvement in demand for steel bars and sheets. Reinforcing bars and structural shapes are now $2.20 per 100 lb. at Pittsburgh mills. Plates, the weakest of the heavy rolled steel products, are $2.10@$2.20 per 100 lb. at mill. These quotations are about 5c. per 100 lb. under the price levels of a month ago.

Brick and Hollow Tile—Declines of $1 per M. on common brick reported in Boston, Minneapolis and Atlanta during month; few other changes throughout the country. Aside from slight declines on large sizes in Birmingham and Cleveland, the hollow tile situation is very much the same as that of brick.

Lumber—There is a slight increase in demand, while production and shipments are considerably slower, compared with one month ago and a year ago. Mill stocks are large and while the general trend is downward there is no evidence of widespread "price cutting."

Explosives — Price schedules unchanged.

Scrap — Quotations published one month ago hold for current buying.

Linseed Oil—Raw oil has advanced 2c. per gal. in New York since June 5. Price level still 13c. per gal. below that of a year ago.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	July 3	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$25.05	$31.05
Northern Basic	24.00	29.77
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	24.00	30.27
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	28.00	36.25
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	*20@21*	27.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	24.25	30.76
Virginia No. 2 (silicon 2.25 @ 2.75)	28.17	34.17
Basic	24.00	28.26
Gray Forge	24.00	28.76
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	24.50	31.61
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	27.00	32.51
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	25.77	29.77
Basic	25.77	28.77
Bessemer	26.77	30.27

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	Birmingham
No. 1 railroad wrought	$14.00	$11.50	11.50@12.00
Stove plate	10.00	12.00	15.50@16.50
No. 1 machinery cast	14.00	16.50	.....
Machine shop turnings	8.00	4.00	7.00@ 8.00
Cast borings	9.00	5.50	15.00@16.00
Railroad malleable	13.00	12.50	.....
Re-rolling rails	14.00	13.00	.....
Re-laying rails	22.00	30.00	.....
Heavy melting steel	10.50	.....	.....

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	July 3	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.80	$46.00
Standard openhearth rails	43.00	43.00	43.00	43.00	46.00
Light rails, 8 to 10 lb.	38@40	45.00	2.00*	43.00	2.55*
Light rails, 12 to 14 lb.	38@40	45.00	2.00*	43.00	2.45*
Light rails, 25 to 45 lb.	*38@40*	45.00	2.00*	43.00	2.35*
Rerolled Rails	*35@36*	39.00	.....	.....	2.10*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.70	$1.90
Chicago, Hardwood and Red Oak	1.35@1.45	1.50@1.70
Chicago....Empty Cell Creosoting (add'l)	.50	.60
San Francisco..... Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.25
St. Louis, White Oak	*1.25*	*1.45*
St. Louis (creosoted) (zinc treated)	*1.65*	*1.90*
St. Louis, Red Oak, plain	*1.15*	*1.35*
St. Louis, Sap pine-cypress	*1.00*	*1.20*
Birmingham, white oak	*1.30*	*1.60*

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	July 3	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, $\frac{5}{16}$-in. and larger	$2.90@3.00	$3.15	$3.00	*$3.75–3.85*	$4.85	**$3.72**
Track bolts	3.75@**4.25**	4.00@4.25	4.00	*3.65–3.90*	5.85	**4.57**
Standard section angle bars	2.75	2.75	2.75	3.45	4.00	**3.20**

PIPE

WROUGHT PIPE—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	48%	50%	61%	49%
2½ to 6 in. lap welded	44%	47%	58%	46%

	Galvanized			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	34%	37%	50%	36%
2½ to 6 in. lap welded	30%	34%	48%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4%, less 5%; class A, plus 23%. Cast iron, standard sizes, 34@5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	Pittsburgh	New York July 3	New York One Year Ago
4 in.	*$52@53*	*$64.60@65.60*	*$65.60@66.60*	$67.30
6 in. and over	49.00	*59.60@60.60*	*60.60@61.60*	62.30

	Chicago	St. Louis	San Francisco
4 in.	$60.20@64.20	$56.60	$63.00
6 in. and over	57.20@60.20	52.60	59.00

Gas pipe and Class "A," $5 per ton extra.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	July 3	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$45.00	$50.00	$62.50	.....	$73.00
4	55.00	55.00	50.00	75.00	$76.50	83.00
5	80.00	80.00	.....	100.00	97.25	108.00
6	105.00	105.00	85.00	175.00	127.50	133.00
8	170.00	170.00	195.00	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	*$0.093*	*$0.105*	.....	$0.15	$0.12	.....
4	.....	*.093*	.11	$0.1175	.15	.15	$0.15
5	.....	*.1395*	*.1375*	.....	.23	.18	.18
6	$0.24	*.1395*	.165	.1645	.23	.21	.21
8	.38	*.217*	**.26**	.26	.35	.30	.325
10	.57	*.3255*	.338	.364	.53	.42	.476
12	.72	*.4185*	*.45*	.468†	.68	.54	.612
15	1.13†	*.558*	.65	.78†	.90	.90	.102
18	1.65†	*.775*	**.90**	1.092†	1.25	1.32	1.153
20	1.98†	*.93*	**1.25**	.....	1.50	.....	.....
22	2.64†	*1.24*	1.375	1.456†	2.00	.....	1.564
24	2.97†	*1.395*	1.625	1.872†	2.25	2.16	2.04
27	4.81†	*2.665*	2.80	2.95†	4.69†	3.00	3.34
30	5.33†	*2.952*	.....	3.65†	5.94†	3.60	4.06
33	6.93†	*3.96*	.....	4.45†	6.88†	.....	4.99
36	7.91†	*4.51*	.....	4.80†	7.50†	.....	5.42

	3	5	8	12	24	36
Boston	*$0.13*	*$0.21*	*$0.32*	*$0.625*	*$2.05†*	*$6.05†*
Minneapolis	.....	.....	.40	.72	2.55†	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	.....	.36	.72‡	2.60†	.....
Los Angeles	.16	.195	.275	.475	1.65	.....
New Orleans	.148*	.207*	.345	.586	1.182	.....
Cincinnati	.111	.1665	.259	.4995	1.665	4.92
Atlanta	.11*	.135*	.225	.3825	1.4625	.....
Montreal	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.108	.162	.252	.486	2.205†	5.8425†
Baltimore	.117	.175	.273	.5265	1.755	5.125
Kansas City, Mo.	.15*	.21*	.33	.60	.....	.....
Philadelphia	.12	.18	.28	.54	1.80	4.61

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	July 3	One Year Ago
New York, 45% asphalt (at terminal)	$0.053	$0.0525
New York, 65% asphalt (at terminal)	.051	.0525
New York, binder (at terminal)	.06	.06
New York, flux (at terminal)	.04	.0575
New York, liquid asphalt (at terminal)	.048	.06
St. Louis, 40@50% asphalt	*.046*	.0535
St. Louis, 50@60% asphalt	*.048*	.0565
Chicago, 40–50% asphalt	.0525	.0525
Chicago, 60–70% asphalt	.055	.055
Dallas, 45% asphalt	.0495	.049
Dallas, 55% asphalt	.0455	.0455
Dallas, binder	.061	.061
San Francisco, binder, per ton	**11.00***	9.50*

* F.o.b. Oelum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Standard refined Mexican*)	$19@20*	$15@16
Boston (*Mexican*)	*21.00*	*16.00*
Chicago (*Stanolind*)	21.00	15.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00	11.00
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	24.75	20.50
Denver (*California*)	24.00	....
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	25.10	19.10
St. Louis (*Trinidad*)	33.00	31.00
Baltimore (*Standard Oil*)	18.00	14.00
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	32.00	28.50
Detroit (*Mexican*)	22.00	18.00
Cincinnati (*Kentucky Rock*)	....	11.65
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	20.50	17.50
Philadelphia (*Mexican*)	22.00	17.00
Kansas City (*Texas*)	27.30	22.30
Los Angeles "*D*" *grade, California, f.o.b. El Segundo Refinery*	17.00	11.00
Birmingham (*Mexican*)	32.00	*28.50*

*In drums.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)	5-in. granite, 30 blocks per sq.yd.	$140.00 per M.
Chicago	About 4x8x4 dressed	3.60 per sq.yd.
	About 4x8x4 common	2.95 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite / 28 blocks per sq.yd.	*133.00* per M.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	137.00 per M.
St. Louis	4x8x4 dressed	*1.65*@1.75 per sq.yd.
	4x8x4 common	*1.65*@1.75 per sq.yd.
Kansas City	Granite	3.85 per sq.yd.
Philadelphia	Granite	*3.00*@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.10 per lin.ft.
Chicago	18 in. wide....No market	.... per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 85c.; 5 x 20 in., Queens, 95c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., 90c. per lin.ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	*$2.28*
New York (*delivered*)	3½	16	*2.48*
Boston	3½	18	*2.60*
Chicago	4	16	3.20
Chicago	3½	16	2.90
St. Louis	3½	16	2.35
St. Louis	4	16	2.65
Seattle	4	16	Off market
Minneapolis	3½	16	2.75
Atlanta	3½	16	2.00
New Orleans	3	16	1.70
New Orleans	3½	16	2.10
New Orleans	4	16	2.50
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3½	16	*2.13*
Detroit	4	16	....
Cincinnati	3½	16	2.38
Kansas City	4	16	3.00
Philadelphia	4	16	None used

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	July 3	One Year Ago	July 3	One Year Ago	July 3	One Year Ago
New York (*alongside dock*)	$1.75	$2.25	$1.75	$2.25	$1.00	$1.25
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	2.00	2.00	2.00	2.00	2.00	2.00
St. Louis	*1.45*†	2.40†	*1.45*†	2.45†	*1.18*†	2.10†
Seattle	1.50	1.25	1.50	1.25	1.50	1.25
Dallas	2.38	2.25	2.38	2.25	2.00	1.95
Minneapolis	1.85*	1.85*	1.85*	1.85*	1.25	1.25
Cincinnati	1.40†	1.50†	1.40†	1.50†	1.35†	1.30†
San Francisco	2.15	2.15	2.15	2.15	1.50	1.50
Boston	1.40†	1.50†	1.40†	1.50†	*1.00*†	1.20†
New Orleans	3.00	2.85	3.00	2.85	1.25	1.25
Los Angeles	2.15	1.35†	2.20	1.45†	1.70	1.10†
Atlanta	2.00†	1.90†	2.00†	1.90†	1.40†	1.24†
Detroit	2.05	1.62	1.75	1.62	1.35	2.02½
Baltimore	1.40	1.86	1.60	2.06	0.70†	0.80†
Montreal	1.25†	1.25†	1.50†	1.50†	1.25†	1.25†
Birmingham	....	....	....	....	1.25†	1.30†
Philadelphia	2.10	....	2.10	....	1.50	....
Kansas City	....	1.75	....	1.60	0.66*	0.66*

New York—Grits, $1.75 per cu. yd.; ready mixed, $2.00
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit. † Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	July 3	One Year Ago	July 3	One Year Ago
New York	$1.75	$1.65	$1.85	$1.75
Chicago	2.00	2.00	2.00	2.00
St. Louis	1.80*	1.75	1.75*	1.65
Dallas	2.83	2.50	2.83	2.50
San Francisco	2.15	2.15	2.15	2.15
Boston	1.45*	1.70*	1.45*	1.70
Minneapolis	1.75	2.00	1.75	2.25
Kansas City	1.50	1.50	1.50	1.50
Denver	3.50	3.50	3.50	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.00*	2.00*	2.00*	2.00
Cincinnati	1.90*	1.65*	1.90*	1.65*
Los Angeles *delivered*	3.00	1.60	3.10	1.60
Detroit	*1.70*	1.75	*1.70*	1.75
Baltimore	2.50	2.50	2.55	2.55
Montreal	1.80*	1.80*	1.90*	1.90*
Philadelphia	2.10	....	2.10	....
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25
Birmingham	....	3.20	....	3.10

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa	0.85	0.90	2.50	....
Birmingham, Ala	*0.90*	1.15	2.05	....
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.45	1.45	1.45	1.25
Eastern Pa. and Northern N. J	1.20	1.20	2.50	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va	1.25	1.25	2.50	1.00
Toledo, Ohio	1.50	1.50	1.50	1.50

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$18.20	$13.10	$3.75*	$3.00@3.25*
Chicago	20.00	20.60	1.50†	1.50†
St. Louis	**24.00**	**20.00**	18.75‡	18.75‡
Boston	20.00	15.00	3.90*	3.10*
Dallas	20.00	....	....	1.85†
Cincinnati	16.80	14.30	....	13.40‡
San Francisco	22.60	22.60	....	**2.15†**
Minneapolis	25.50	21.00 (white)	1.70†	1.40†
Denver	24.00	....	....	2.70†
Detroit	22.00	20.00	....	20.00‡
Seattle, *paper sacks*	24.00	....	2.80†	....
Los Angeles	....	18.50	....	2.00†
Baltimore	24.25	17.85	2.55†	....
Montreal	21.00	21.00	....	10.50‡
Atlanta	22.50	14.00	2.25†	1.65†
New Orleans	24.00	18.00	2.40†	1.90†
Philadelphia	23.00	16.00	22.00‡	1.24†
Kansas City	18.40	18.40	3.92*	2.57*
Birmingham	**15.00**	13.75	**2.00†**	**1.80†**

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.80, Sheboygan $1.70. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	July 3	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.80	1.50
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	*2.50*	2.70
St. Louis (Carney)	2.45	2.85
Birmingham (Magnolia) pozzolan cement	2.10	2.10

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	July 3	One Month Ago	One Year Ago
New York, del. by truck	$2.50@2.60	$2.50@2.60	$2.70@2.80
New York, alongside dock to dealers	2.15	2.15	2.30
Jersey City	2.33	2.33	2.48
Boston	*2.63*	2.65	2.80
Chicago	2.20	2.20	2.20
Pittsburgh	2.19	2.19	2.24
Cleveland	2.39	2.39	2.46
Detroit	2.40	2.40	2.48
Indianapolis	2.41	2.41	2.41
Milwaukee	2.35	2.35	2.37
Duluth	2.19	2.19	2.14
Peoria	2.37	2.37	2.41
Cedar Rapids	2.40	2.40	2.48
Davenport	2.39	2.39	2.43
St. Louis	2.30	2.30	2.35
San Francisco	2.61	2.61	2.71
New Orleans	2.40	2.40	3.30
Minneapolis	2.42	2.42	2.39
Denver	2.84	2.84	2.84
Seattle	2.90	2.90	2.90
Dallas	2.05	2.05	2.25
Atlanta	2.35	2.35	2.85
Cincinnati	2.47	2.47	2.54
Los Angeles	3.00	3.00	3.20
Baltimore	2.50	2.50	2.65
Birmingham	2.65	2.65	2.70
Kansas City	2.27	2.27	2.45
Montreal	*1.90*	2.25	2.25
Philadelphia	2.41	2.41	....
St. Paul	2.42	2.42	2.39
Toledo	2.45	2.45	2.48

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.95	Hudson, N. Y.	$2.05
Universal, Pa.	1.95	Leeds, Ala.	1.95
Steelton, Minn.	2.00	Hannibal, Mo.	2.05
Fordwick, Va.	2.05	Lehigh Valley District	1.95
Mitchell, Ind.	2.05	Wyandotte, Mich.	2.15
Iola, Kan.	1.95	Alpena, Mich.	2.00
Mason City, Ia.	2.00	Richard City, Tenn.	2.05
La Salle, Ill.	2.05	Kingsport, Tenn.	2.05

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0.95	$1.02	$1.24	$1.04	$1.13	*$1.15*
049	28	1.20	1.30	1.58	1.32	1.38	*1.45*
068	35	1.47	1.59	1.94	1.62	1.67	*1.78*
093	45	1.89	2.04	2.50	2.08	2.00	*2.28*
126	57	2.34	2.53	3.09	2.59	2.55	*2.85*
153	68	2.79	3.02	3.60	3.08	3.15	.....
180	78	3.20	3.47	5.22	3.54	3.47	.....
245	103	4.22	4.57	4.60	4.66	4.58	.....
287	119	4.88	5.28	6.44	5.39	5.26	*5.94*
036	138	5.66	6.13	7.39	6.25	6.11	.....
095	160	6.56	7.10	8.67	7.25	7.12	.....
			PAVING				
036P	17	$0.72	$0.78	$0.95	$0.79	$0.76	.....
053P	24	1.02	1.10	1.35	1.12	1.07	.....
072P	31	1.29	1.40	1.71	1.42	1.39	.....
097P	40	1.66	1.80	2.20	1.83	1.90	.....
040R	24	.....	1.10	.....	1.12	1.07	.....
067R	31	.....	1.40	.....	1.42	1.39	.....
089R	40	.....	1.80	.....	1.83	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Weight in pounds	New York	Chicago	St. Louis	San Francisco	Dallas
2.2	$22.00	$19.00	$20.00	$19.00	$25.50
2.5	22.00	21.00	21.00	21.50	27.58
2.8	22.00	22.50	24.50	.....	30.71
3.0	24.00	24.50	26.50	23.00	33.16
3.4	27.00	26.50	29.00	.....	35.10

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Warehouse, Uncut: Birmingham	New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger..	*$2.20*	$3.30	*$3.34*	$3.20	*$3.30*	$3.38	$3.65
⅝.....	*2.25*	3.45	*3.44*	3.25	*3.35*	3.43	3.75
¾.....	*2.30*	3.50	*3.54*	3.30	*3.50*	3.48	3.85
⅞.....	*2.45*	3.75	*3.74*	3.45	*3.70*	3.63	4.05
1.....	*2.70*	4.35	*4.34*	3.70	*4.30*	3.78	4.65

For size and cutting extras, manufacturers and distributers, see bar card of July 1, 1923.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$2.30	*$3.00*	$3.08	⅝.....	$2.70	*$3.20*	$3.30
⅝ in.....	2.40	*3.05*	3.13	¾.....	3.30	3.50	3.48
¾.....	2.50	*3.10*	3.18	.....	.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: July 3	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.).....	$23.65	$23.65	$23.50	$46.50	$53@54
New York (at dock)...	20.00	20.00	20.00	.....	.....
Chicago.....	11.00	11.00	11.00	34.00	42.00
St. Louis, salmon.....	16@18	16@18	16@18	*38@40*	40@42.50
Denver, salmon.....	12.00	12.00	12.00	.....	.....
Dallas.....	14.10	14.10	13.10	35.00	.....
San Francisco.....	15.50	15.50	15.00	.....	.....
Los Angeles.....	14.50	14.50	15.00	(not used)	
Boston (del.).....	*21.50*	22.50	22.50	*48.00*	56.00
Minneapolis (del.).....	*13.00*	14.00	17@19	.....	.....
Kansas City.....	16.50	16.50	14.50	(no market)	
Seattle.....	15.00	15.00	13.00	.....	58.50
Cincinnati.....	17.00	17.00	17@20	40.00	45.00
Montreal.....	17.50	17.50	16.50	100.00†	68.00
Detroit (del.).....	17.50	17.50	20.00	38.50	41.50
Baltimore.....	18.00	18.00	21.00	40.00	45.00
Atlanta.....	*11.00*	12.00	14.00	40.00	45.00
New Orleans.....	19.50	19.50	18.75	.....	.....
Birmingham.....	12.50	12.50	13@16	(no market)	
Philadelphia.....	19.00	19.00	.....	38.00	46.00
Pittsburgh (del.).....	16.00	16.00	16.00	.....	.....
Cleveland.....	16.00	16.00	16.00	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: July 3 on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12...	$0.1162	$0.1573	$0.064	$0.125	$0.078	$0.108	.....
6x12x12...	.1743	.2097	.088	.....	.106	.156	.....
8x12x12...	.2179	.2621	.12	.215	.14	.244	.....
10x12x12...	.....	.....	.1511	.....	.165	.....	$0.2786
12x12x12...	.....	.....	.176	.....	.21	.....	.3448

* 5 per cent off for cash.

	4x12x12	8x12x12	12x12x12
Boston.....	$0.125	$0.23	.....
Minneapolis (f.o.b. cars).....	.073	.12	$0.215
Minneapolis (delivered).....	.08	.13	.23
Cincinnati.....	.07485	.13745	.....
Kansas City.....	.086	.158	.....
Denver.....	.075	.123	.188
Seattle (delivered).....	.11	.25	.36
Los Angeles.....	.0931	.1686	.....
New Orleans.....	.14	.24	.....
Detroit (delivered).....	.1044	.1958	.2737
Montreal.....	.12	.225	.30
Baltimore.....	.125	.27	.....
Atlanta.....	.091	.1516	.....
Dallas.....	.11	.20	.285
Birmingham.....	.11	.175	.....
Pittsburgh (delivered).....	.068	.128	.1793
Cleveland.....	.08	.14	.....

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Warehouse: Birmingham	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.....	*$2.20*	$3.00	*$3.44*	*$4.20*	$3.45	$3.30	$3.60
Channels, 3 to 15 in....	*2.20*	3.00	*3.44*	*4.20*	3.45	3.30	3.60
Angles, 3 to 16 in., ¼ in. thick.....	*2.20*	3.00	*3.44*	*4.20*	3.45	3.30	3.60
Tees, 3 in. and larger...	*2.20*	2.90	*3.44*	*4.20*	3.50	3.30	3.60
Plates, ¼ in. thick and heavier.....	*2.10@2.90*	3.00	*3.44*	*4.20*	3.45	3.30	3.60

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York July 3	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in.....	$2.60@2.75	$4.00	$4.40	$3.75	$3.90	$5.00	$4.90
CONE HEAD BOILER							
½ in.....	$3.00	$4.10	$4.50	$3.85	$4.10	$5.20	$5.00
⅝ and ¾.....	3.15	4.26	4.66	4.00	4.45@4.70	5.35	5.15
⅞ and 1.....	3.40	4.50	4.90	4.25	4.85	5.60	5.5

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.....	$2.90	$4.50	$3.80	$4.10	$4.55	*$3.25*	$4.95
Cut.....	3.00	5.50	4.45	5.25	5.75	*3.49*	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
½.....	$6.25	$6.20	$7.75
⅝.....	5.85	5.80	5.75
¾.....	5.65	5.65	5.35

Pittsburgh base in lots of 200 kegs or more, $3.25@3.40.

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.64 per roll to consumers in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $6.95 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., $6.10 per square.

ROOFING MATERIALS—Prices f.o.b. New York, to consumers in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton.....	$85.73
Tar pitch (in 400-lb. bbl.), per 100 lb.....	2.13
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....	40.50
Asphalt felt (light), per ton, f.o.b. plant*.....	87.75
Asphalt felt (heavy), per ton, f.o.b. plant*.....	87.75

* Delivered in Metropolitan Dist., $2.00 additional.

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 82 per cent; "A," 86 per cent; "B," 88 per cent. Double thickness "AA," 82 per cent; "A," 85 per cent; "B," 88 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10.....	*$2.75@2.80*	$4.10	$4.00	$5.00	$4.14
No. 12.....	*2.85@2.90*	4.15	4.05	5.05	4.19
No. 14.....	*2.95@3.00*	4.20	4.10	5.10	4.24
No. 16.....	*3.15@3.20*	4.30	4.20	5.20	4.34
Black					
*Nos. 18 and 20.....	3.60@3.70	4.80	4.55	5.60	4.65
*Nos. 22 and 24.....	3.65@3.75	4.85	4.55	5.65	4.70
*No. 26.....	3.70@3.80	4.90	4.60	5.70	4.75
*No. 28.....	3.75@3.85	5.00	4.70	5.80	4.85
Galvanized					
No. 10.....	$3.85@3.95	5.00	4.60	5.50	4.90
No. 12.....	3.95@4.05	5.10	4.70	5.60	5.00
No. 14.....	3.95@4.05	5.10	4.70	5.60	5.00
Nos. 17 to 21.....	4.25@4.35	5.40	5.00	5.90	5.30
Nos. 22 and 24.....	4.35@4.45	5.55	5.15	6.05	5.45
*Nos. 25 and 26.....	4.45@4.55	5.70	5.30	6.20	5.55
*No. 28.....	4.75@4.85	6.00	5.60	6.50	5.85

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: July 3	New York: One Year Ago	Chicago: July 3	Chicago: One Year Ago
Raw in barrels (5 bbl. lots).....	$1.00	$1.13	$0.94	$1.28

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry		In Oil	
	July 3	1 Yr. Ago	July 3	1 Yr. Ago
Red	15.00	14.50	16.50	16.00
White	15.00	14.50	15.00	14.50

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft	25 to 32 Ft.
3x3 and 4	$35.00	$36.00	$37.00	$40.00
3x6 and 8	35.00	36.00	37.00	40.00
4x4-6 and 8	35.00	36.00	37.00	40.00
3x10 and 12	35.00	36.00	37.00	40.00
3x14	39.00	39.00	41.00	43.00
4x10 and 12	35.00	36.00	37.00	40.00
4x14	39.00	39.00	41.00	43.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$37.00	$39.00	$41.00
6x14	38.00	40.00	42.00
8x10	37.00	39.00	41.00
8x14	38.00	40.00	42.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	*$42.00*	*$43.00*	$41.50	$43.50
3x10 to 10x10	*46.00*	*47.00*	46.50	48.50
3x12 to 12x12	*52.00*	*53.00*	51.50	53.50
3x14 to 14x14	60.00	61.00	57.50	59.50
3x16 to 16x16	70.00	71.00	67.50	69.50
3x18 to 18x18	.....	.....	77.50	79.50
4x20 to 20x20	.....	.....	86.50	88.50

*Wholesale price to dealers; to contractors, delivered from lighters or cars to ob, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	*$57.00*	*$60.00†*	$50.00	$50.00	*$65.00*	*$75.00†*
Seattle	.....	29.50	.....	.....	.....	*23.00*
New Orleans	*29.00*	.....	.....	.....	*39.00*	.....
Baltimore	32.50	49.25	53.00	60.00	38.00	49.75
Cincinnati	40.00	74.00	74.00	88.00	44.00	78.00
Montreal	50.00	58.00	.....	.....	60.00	65.00
Los Angeles	.....	49.00	.....	.....	.....	50.00
Denver	.....	*35.75*	36.75	36.74	.....	*36.75*
Minneapolis	40.00	38.75	39.00	.....	43.10	39.75
Atlanta	*33.00*	.....	.....	.....	*36.00*	.....
Dallas	*52.25*	.....	.....	.....	*57.20*	.....
Kansas City	43.50	48.50	.....	.....	54.50	49.50
Birmingham	24@30	.....	.....	.....	*25@31*	.....
Philadelphia	*45.00*	*36.00*	*41.50*	*43.00*	*55.00*	*37.00*
Detroit	46.75	46.75	.....	.....	49.75	46.75
St. Louis	42.00	.....	.....	.....	54.00	.....

	1-In. Rough, 10 In. x 16 Ft.—and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	$47.00	*$48.00†*	$45.00	*$52.00*	*$55.00†*
Seattle	.....	25.00	.....	.....	29.00
New Orleans	*67.00*	.....	.....	*33.00*	.....
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	75.00	80.00	75.00	38.00	88.00
Montreal	56.00	50.00	45.00	45.00	45.00
Los Angeles	.....	49.00	.....	.....	.....
Denver	.....	*33.25*	34.25	.....	*29.25*
Minneapolis	43.00	35.25	35.50	37.00	32.25
Atlanta	*21.00*	.....	.....	*31.00*	.....
Dallas	*52.25*	.....	.....	*55.73*	.....
Kansas City	80.50	46.00	.....	77.50	.....
Birmingham	.....	.....	.....	24@42	.....
Philadelphia	*29.00*	*36.00*	*41.00*	*45.00*	*35.00*
Detroit	38.75	35.00	.....	14.00	36.75
St. Louis	41.00	.....	.....	30.00	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M.ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.
*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

July 3	One Month Ago	One Year Ago
$2.30@2.40	$2.35@2.40	$2.65

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern New York and East of Missouri River	Territory West of Missouri River
Hercules red strand, all constructions	20%	
Patent flattened strand, special steel wire rope	20%	
Patent flattened strand, iron rope	5%	
Plow steel round strand rope	35%	
Special steel round strand rope	30%	
Cast steel round strand rope	20%	
Round strand iron and iron tiller	5%	
Galvanized steel rigging and guy rope	7½%	
Galvanized iron rigging and guy rope	+12½%	

California, Oregon, Nevada and Washington Discount: 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arisona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ⅝-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils:

Boston	$0.17½@.22	New Orleans	$0.17½
New York	.19½	Los Angeles	.20
Chicago	.18	Seattle	.18
Minneapolis	.19½	St. Louis	.18½
San Francisco	.17	Montreal	.16
Atlanta	.22½	Detroit	.20
Denver	.19½@20½	Baltimore	.18
Cincinnati	.21	Kansas City	.19½
Dallas	.21	Birmingham	.23
Philadelphia	.18½		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.23	.25
Kansas City	.2275	.2475
Seattle	.165	.19
Chicago	.22	.25
Minneapolis	.1917	.2123
St. Louis	.22	.245
Denver	.2025	.2275
Dallas	.225	.302
Los Angeles	.1925	.2225
Atlanta	.23	.255
Baltimore	.22	.23
Cincinnati	.2125	.2325
Montreal	.195	.235
Birmingham	.16	.17
New Orleans	.235	.29
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f. o. b. New York:

Sulphate of aluminum, in bags, per 100 lb.	$1.35@1.40
Sulphate of copper, in bbl., per 100 lb.	4.65@4.80
Soda ash, 58%, in bags, per 100 lb.	1.25@1.45
Chlorine, liquid, cylinders, 100 lb., per lb. (f.o.b. works)	.05½@.07½
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	2.25@2.35

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.58	Kansas City	.735
Boston	.365	New Orleans	.67
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.15*
Cincinnati	.29	Philadelphia	.32
Cleveland	.215	St. Louis	.43
Denver	1.15*	St. Paul	.60

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.